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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

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BOTANY—VOL. I.

REPORT ON THE PRESENT STATE OF KNOWLEDGE OF VARIOUS INSULAR FLORAS

BY WILLIAM BOTTING HEMSLEY, A.L.S.

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EDITORIAL NOTES.

This Report, dealing with the present state of knowledge of various Insular Floras, forms an Introduction to the first three of the Botanical Series of Reports on the Scientific Results of the Expedition.

Botanical notes for the guidance of the Naturalists of the Expedition were prepared at the Royal Gardens, Kew, previous to the departure of the Challenger, and were incorporated in the instructions drawn up by the Circumnavigation Committee of the Royal Society.[1]

The botanical collections of the Expedition referred to in this Report were made by Mr H. N. Moseley during the cruise, and despatched direct to Kew from various ports touched at by the Expedition. Preliminary notices of these collections, and notes by Mr Moseley on the general aspects of the vegetation of many of the places visited, were from time to time published in the Journal of the Linnean Society.[2]

The Continental botanical collections made during the voyage being very fragmentary, it was determined to limit these Reports to a review of the Insular Floras which came within the range of the Expedition, combining for this purpose the materials already in existence at the Royal Gardens, Kew, and at the British Museum, with the new facts brought to light by the Challenger collections.

The task of preparing these Reports dealing with the Insular Floras was, on the recommendation of Sir Joseph D. Hooker, K.C.S.I., C.B., F.R.S., intrusted to Mr William Botting Hemsley, A.L.S., who writes—

"When asked whether I would undertake to report on the Botany of the Challenger Expedition, the report to be restricted to Insular Floras, I unhesitatingly replied in the affirmative, because I felt assured of the friendly assistance not only of the botanists at Kew and the British Museum, but also of various specialists in cryptogamic botany. In

[1] Narr. Chall. Exp., vol. i., 1885, p. 27 *et seq.*

[2] For a list of these publications see Narr. Chall. Exp., Bibliography, Appendix VI. pp. 1053–1063.

this I was not mistaken; and it is now a pleasant duty to record my obligations and convey my thanks to those gentlemen to whom I am indebted for giving me the benefit of their experience, and thereby adding greatly to the value of my work. From long association with Sir Joseph Hooker in botanical work I had become, through his influence, particularly interested in the study of Insular Floras—an interest first awakened when I had the advantage of examining with him, now more than twenty years ago, a large number of New Zealand plants in connection with his Handbook of the Flora; but it was only as I advanced with my present work that I more fully realised the difficulties of the task before me, and the impossibility, notwithstanding that I was receiving so much help from others, of my being able to accomplish it in a manner wholly satisfactory to myself. As I proceeded, facts accumulated to an unexpected extent, and the number of questions and issues involved increased at every step. At first I was rather inclined to speculations; but I soon became aware that a careful collection of facts, and a conscientious examination of the evidence upon which certain theories and statements connected with Insular Floras had been founded, would be of more value than a speculative treatment of the subject. Imbued with this idea, I have to a great extent left the facts to speak for themselves; yet, without attempting a final solution of the many problems which I encountered, I have not altogether abstained from expressing my own opinions, nor from pointing out what appeared to me the correct deductions from the facts adduced. This change in the method of treatment will explain any little inequalities in the work, because the first part was printed before the writing of the second was finished, and the second was printed before the writing of the third was begun, while the Introduction was mainly written after the whole of the other was in type.

"Due acknowledgment has been made in the proper places of information extracted from published works and unpublished documents, as well as to contributors of dried plants from the various islands, so that it only remains for me to mention those who have afforded me active help—help which has saved me from many a pitfall, and largely compensated for my own inexperience in some branches of botany, and for which I am glad of this opportunity of expressing my sincere thanks.

"The work was intrusted to me under the superintendence of Sir Joseph Hooker, and I am under special obligations to him for his guidance, for placing at my disposition all his notes and references relating to Insular Floras, and also for reading the proofs as they issued from the press. I had hoped that he himself would write the Introduction, but his multifarious duties rendered it impracticable. Professor Oliver's aid I cannot overestimate, for he has throughout permitted me to consult him upon points of detail as they arose, and as we were usually working in the same room I have profited by it on numberless occasions. Mr W. T. Thiselton Dyer, who has taken the greatest interest in the work from the beginning, has also read the proofs and assisted me in many ways, more especially in searching out interesting facts bearing upon my subject from the voluminous official

correspondence at Kew. Mr J. G. Baker has given me direct help in drawing up the lists of ferns; Mr Mitten in mosses and liverworts; the Rev. J. M. Crombie in lichens, and Dr M. C. Cooke in fungi; and these gentlemen, together with the Rev. M. J. Berkeley, Dr Nylander, the late Professor G. Dickie, and Dr Reinsch, have between them named all the cryptogams. In some instances I have ventured to add references to descriptions, and to give some of the more important synonyms, as well as the distribution of the species; but I have been careful to discriminate between their work and my own in order that they should not suffer from any errors into which I may have fallen. As mentioned elsewhere, Mr Carruthers and Mr Britten spared themselves no trouble in searching through the earlier collections at the British Museum, especially the Sloane Herbarium, for plants coming within the scope of my work; and I may add that more use might have been made of the British Museum collections of Polynesian plants, but as I had to deal with such a very small fragment of the Flora (Admiralty Islands only) it was not thought necessary, especially as Seemann enumerates, in his Flora Vitiensis, all the species he met with in the British Museum Herbarium. His work, however, is in a measure supplemented by a number of unpublished lists of comparatively recent collections of insular plants at Kew, partly in the general Introduction, and partly in the Report on the Botany of the South-eastern Moluccas.

"Finally, it gives me much pleasure to mention that Miss Matilda Smith has taken great pains with the drawings made from dried plants, and especially with the dissections of the flowers.

"With regard to the details nothing more need be said here, as everything is explained that seemed to require explanation in the body of the work. I may repeat, however, that full references are given in only one place for such plants as occur in more than one of the florulas contained in each part of the Reports."

The manuscript of this Report was received by me on the 25th March 1885.

JOHN MURRAY.

CHALLENGER OFFICE, 32 QUEEN STREET,
EDINBURGH, 1*st June* 1885.

THE

VOYAGE OF H.M.S. CHALLENGER.

BOTANY.

REPORT on Present State of Knowledge of various Insular Floras, being an Introduction to the Botany of the Challenger Expedition. By William Botting Hemsley, A.L.S.

PRELIMINARY REMARKS.

In the Introductory Notes on the vegetation of the various islands included in the Reports on the Botany of the Expedition, are embodied tables showing the distribution of the genera and species of each island or group of islands. There are also observations on the composition, affinities, &c., of the different insular floras, together with references to the diverse agencies operating in the dispersal of plants, whilst numerous facts and suggestions bearing upon the same subject are scattered throughout the lists. Finally, the Appendix to the third Part of the Botany is devoted to the record of evidence of the part played by oceanic currents and birds in the transport of seeds from place to place.

This General Introduction is not limited to a mere summary of the facts contained in the Reports, and speculations thereon; it has been so extended as to form an epitome of the Botany of a large number of Oceanic Islands, and of the Antarctic Regions generally. The special characteristics of Insular Vegetation in various parts of the world are set forth and compared with continental vegetation; and, as a whole, the work may perhaps serve as an indication to travellers of the nature and extent of the observations required for the advancement of this most interesting subject.

LITERATURE RELATING TO INSULAR FLORAS.

A list of works devoted to, or bearing upon this subject, is given at the end of this Introduction; but it seems desirable to say a few words respecting the teachings of a few travellers and authors who have specially investigated or promoted the philosophical

investigation of Insular Floras and Faunas. Although there are references in the writings of botanists of the last half of the eighteenth century, and of the first half of the present century, to some of the peculiar features of Insular Floras and Faunas, it is only within the last fifty years, or thereabouts, that their composition and origin have been the object of particular study.

Darwin, C.—The works of Darwin are so widely read that it seems almost superfluous to enter into any details here respecting their nature and scope. His Journal of Researches, and Origin of Species, abound in facts and suggestions relating to the distribution of plants and animals. It was he who first recognised, or at least thoroughly investigated, the means of transoceanic migration; and it is to him that we are so largely indebted for directing the thinking and observing powers of the present generation of naturalists in the proper channels for obtaining true knowledge. He also conducted a number of experiments to ascertain the capability of certain seeds to bear immersion in salt water without injury, and made various investigations showing how seeds are conveyed by birds in their feet and beaks, and in their stomachs. In short, he practically laid the foundation of the inquiry into the means and modes by which remote islands became stocked with plants and animals.

Hooker, Sir J. D.—The first work of importance by this author is his Essay on the Vegetation of the Galapagos Archipelago, concerning the botany of which nothing was previously known. Two-thirds of the species enumerated were new to science, and so distinct in character as to afford materials for the foundation of a new branch of botanical inquiry in relation to the means by which the seeds of plants are conveyed long distances, and their species thereby diffused. It is perhaps the first work on Insular Floras of a philosophical character, and the forerunner of and guide to subsequent literature on the same subject. The seeds and seed-vessels of the various plants are described, and their capabilities for transport by various means indicated; and the affinities and origin of the Flora fully discussed.

The Botany of the Antarctic Voyage contains much relating to Insular Floras, and more especially that part of it entitled the Antarctic Flora, which embodies all that was known forty years ago concerning the flora of a portion of the region to which the islands from the Tristan da Cunha group to the Macdonald group belong. The first part consists of the Flora of Lord Auckland and Campbell Islands, and the second deals with Fuegia, the Falklands, and the Tristan da Cunha group, and other islands eastward to Kerguelen Island. Previously, nothing of importance had been published on the botany of this region; and subsequently the same author has published various other papers relating thereto, for which we refer to the bibliography at p. 81. The Introductory Essay on the Australian Flora in the Flora Tasmaniæ—a work of immense labour, executed at a time

when at least a third of the plants had not been described, and the existing literature was very much scattered, has been the basis of all subsequent inquiries in the same direction, and later discoveries go towards completing the pictures there outlined. The section devoted to the consideration of the Antarctic or Alpine element of the Australian Flora is of special interest in connection with the present work.

The only other work by Sir Joseph Hooker demanding notice in this place is the Lecture on Insular Floras delivered by him before the British Association in 1866. In this the general features of the vegetation of remote oceanic islands are explained, and the special characteristics and affinities of the floras of various islands and groups described. Commencing with the Madeiran group, the author continues with the Canaries, Azores, St Helena, Ascension, concluding with Kerguelen Island. He then proceeds to discuss the hypotheses that have been invented by naturalists to account for the presence of continental plants in oceanic islands, and for those various differences between insular and continental Floras previously indicated.

Watson, H. C.—The author of the Cybele Britannica, and other works on the distribution of British plants, was so great an originator in this special branch of study that his name will endure as long as phytogeography is cultivated. Not the least among the merits of his works is the careful classification of British plants, based upon their claims to be regarded as aboriginally native, and upon the extent to which assumed naturalised species had established themselves. He was the first, we believe, to distinguish fully the introduced from the indigenous element of a flora; and the first to recognise the different "types of distribution" represented in the vegetation of a country.

Forbes, E.—Although this writer's contributions to the literature of phytogeography are, like Watson's, limited almost exclusively to British plants, his theories are of general application. His essay on the Geological Relations of the Fauna and Flora of the British Isles was the forerunner of all speculations on the migration of plants in relation to geological changes.

De Candolle, A.—The Geographie Botanique Raisonnée is a work remarkable for the skilful co-ordination of a vast array of facts, and the logical precision of the arguments; but so little was known of Insular Floras at that date that it was impossible for the author to enlarge upon the subject. A chapter (p. 1278) is devoted to the question whether islands possess a smaller number of species on the same area than continents, which is substantially answered in the affirmative, save for such as are most favourably situated.

Wallace, A. R.—In his Island Life, Wallace specially deals with the distribution and the origin of the plants and animals inhabiting islands. He classifies islands according to their "two distinct modes of origin," continental and oceanic. The latter he assumes have

never formed part of a continent or any large mass of land, and bases his arguments concerning the origin of their plants and animals thereon. Their volcanic or coralline formation, with the exception of the Seychelles,[1] New Caledonia, and New Zealand, and the total absence of indigenous mammalia and amphibia, are accepted as proof of their having always been isolated.

The following extract contains his definitions of continental islands :—

"Recent continental islands are always situated on submerged banks, connecting them with a continent, and the depth of the intervening sea rarely exceeds 100 fathoms. They resemble the continent in their geological structure, while their animal and vegetable productions are either almost identical with those of the continent, or if otherwise, the difference consists in the presence of closely allied species of the same types, with occasionally a very few peculiar genera. They possess in fact all the characteristics of a portion of the continent, separated from it at a recent geological period.

"Ancient continental islands differ greatly from the preceding in many respects. They are not united to the adjacent continent by a shallow bank, but are usually separated from it by a depth of sea of a thousand fathoms or upwards. In geological structure they agree generally with the more recent islands; like them they possess mammalia and amphibia, usually in considerable abundance, as well as other classes of animals; but these are highly peculiar, almost all being distinct species, and many forming distinct and peculiar genera or families. They are also well characterised by the fragmentary nature of their fauna, many of the most characteristic continental orders or families being quite unrepresented, while some of their animals are allied, not to such forms as inhabit the adjacent continent, but to others found only in remote parts of the world. This very remarkable set of characters marks off the islands which exhibit them as a distinct class, which often present the greatest anomalies and most difficult problems to the student of distribution."

The zoological characteristics of these three classes of islands are often associated with parallel botanical peculiarities; but, owing to the more numerous and potent agencies operating in the distribution of plants, their peculiarities are usually very much less pronounced.

In illustration of his classification, Wallace examines and discusses the composition of the faunas, and less fully of the floras, of the Oceanic Azores, Bermudas, Galapagos, St Helena, and Sandwich Islands; of the Recent Continental Islands, Great Britain, Borneo, Java, Japan, and Formosa; and of the Ancient Continental, the Madagascar group; while the Celebes and New Zealand are treated as Anomalous Islands, because their plants and animals exhibit a blending of those characteristic of "oceanic" and "continental" islands.

The more complete botanical researches for the present work have brought to light some additional facts confirming generally the views enunciated by Darwin, Hooker, and Wallace, and more fully set forth by Wallace in the book under consideration. There is, however, one important exception. All Wallace's speculations on former land connections

[1] Eruptive rocks have been discovered in these islands. See Velain, Mission de l'Ile de St Paul, pp. 440–450.

are based upon the present relative depths of the intervening seas, and, while admitting, or rather suggesting, a former connection between New Zealand and Eastern Australia, he utterly rejects Captain Hutton's theory of a southern continent uniting the former with South America, and perhaps also with South Africa. Without going so far as Hutton, we think the botanical evidence, as explained further on, strongly favours a former greater land connection in a lower latitude in the south temperate zone than Wallace admits, and we cling to this "forlorn hope of the botanical geographer," as Sir Joseph Hooker terms it; for all the various means by which plants are diffused seem to be inadequate to account for the present distribution of plants in the coldest southern zone of vegetation.

Seemann, B.—This author merits special mention here for the immense amount of information concerning the vegetation of Polynesia he embodied in his Flora Vitiensis. How much it contains is only apparent on a thorough examination of the work, for he gives no summary nor tabular view of the distribution of the vegetation. He utilised the collections made by the early voyagers, as well as various unpublished documents relating thereto, in the British Museum.

Grisebach, A. H. R.—The chapter on Oceanic Islands in Die Vegetation der Erde (and especially as supplemented in the French edition of Tchihatchef) is doubtless the best general account in existence of the botany and geology (the latter only in the French edition) of oceanic islands; but there are a great many blanks in the floral statistics, a number of which are more or less filled by the present work; and these insular floras are considered by Grisebach apart from all continental floras.

Moseley, H. N.—Independently of the collections of dried plants, the drift-seeds and seed-vessels, and the seeds from the crops of pigeons, Mr Moseley has in various publications recorded the observation of a large number of facts bearing on plant geography, which add much to the value of the Reports on the Botany of the Expedition.

CLASSIFICATION OF ISLANDS IN RELATION TO THE COMPOSITION OF THEIR VEGETATION.

The classification of islands proposed by Wallace, whose definitions are reproduced on the preceding page, harmonises on the whole very well with differences in the characteristic features of the vegetation of some islands; but it is not adapted for exhibiting the floral peculiarities of islands generally—because, apart from latitude, the sources of the vegetation of oceanic islands, for example, are obviously so various that a classification based on age and the degree of isolation alone is inapplicable. A glance at the composition of the vegetation of the Bermudas and the Galapagos is sufficient to show that these two groups

of islands cannot be placed in the same category. Relative age, however, which, after all, is the fundamental principle of Wallace's classification, is in a measure indicated by the nature of the flora; yet we have no such striking voids in the floras of oceanic islands generally as that caused in the faunas by the absence of land-mammalia and amphibia. The indigenous vegetation[1] of oceanic islands presents physiognomical rather than structural characteristics, but even such peculiarities are repeated in continental situations; therefore insular vegetation of the most ancient type cannot be said to possess any absolute peculiarities. Certain forms predominate, governed by physical conditions, but, as is more fully explained in succeeding paragraphs, counterparts, or even exaggerations of them, occur on continents. In short, all the characteristic features of insular floras are reproduced elsewhere, except the invariable poverty in species in relation to area; and as this is not due to the same causes operating in continental desert tracks, the cases are not parallel. The general characters of remote insular floras are: relatively large ordinal and generic representation; preponderance of endemic species, often belonging to endemic genera; woody and often subarboreous habit of a large number of the species; prevalence of small, narrow leaves, and absence or great rarity of brilliantly coloured flowers; but the exceptions of different kinds are numerous, and each island or group of islands usually presents some special feature.

For phyto-geographical purposes Insular Floras may be divided into three categories, based upon their endemic element:—1. Vegetation comprising a large endemic element, including distinct generic types, the nearest affinities of which are not always all to be found in any one continent; 2. Vegetation comprising a small, chiefly specific, endemic element, the derivation of which is easily traced; and 3. Vegetation comprising no endemic element. To the first category belong St Helena, Juan Fernandez, the Sandwich, Galapagos, and Seychelles groups; to the second, the Bermudas, Azores, Ascension, the islands in the southern part of the Indian Ocean, and the Admiralty Islands; to the third, the Keeling, and numerous other rising coral islands in the Indian and Pacific Oceans. This classification is not altogether satisfactory, because, if extended to islands generally, the second category must include insular floras in which there is no endemic element; such, for example, as Spitzbergen and Iceland; but the difficulty is more apparent than real, as the third category is intended to be limited to islands which have become stocked with plants in comparatively recent times.

Before proceeding to the discussion of the means by which these various islands became, or probably became, endowed with flowering plants, we will give some details of the vegetation of some islands and groups of islands not touched upon in the Reports; and also fuller particulars concerning the general distribution of certain natural Orders, together with other evidence bearing upon the inquiry.

[1] We repeat here that any plant that has certainly or apparently reached an island independently of human agency, no matter how recently, nor how sparsely it may be represented individually, is regarded as indigenous.

LISTS OF THE PLANTS AND ANALYSES OF THE COMPOSITION OF THE FLORAS OF VARIOUS ISLANDS NOT INCLUDED IN THE REPORTS.

I.—VEGETATION CONTAINING A LARGE ENDEMIC ELEMENT, INCLUDING DISTINCT GENERIC TYPES.

THE SANDWICH ISLANDS.[1]

"Of the flowering plants, the most remarkable family is the Lobeliaceæ, represented by six genera, five peculiar to the Hawaiian Islands, and thirty-five species, all endemic. Many of these, indeed almost all, are arborescent, and some of great interest. Our [the American] explorations added ten new species and one very remarkable genus (*Brighamia*) to this family. The Compositæ hold an important place, as will be seen by the accompanying table, and of these the new genus *Hesperomannia* and four new species were collected for the first time.

"Remy endeavoured to divide the island flora into five zones, but with indifferent success; three are tolerably distinct,—the alluvial plains, the valleys, and the mountain region. The alluvial plains are on the shores, where most of the introduced plants are found. The valleys, which have generally been long the residence of man, and have been cultivated and cleared, are more tropical, and because better watered than the plains, and of richer soil than the mountains, are filled with a much more luxuriant vegetation; in this region are found most of the introduced fruits. The third, or mountain region, extends from the grass lands which usually occupy the lower slopes of the mountains as high as eight hundred or a thousand feet, almost to the limit of vegetation, and this point is determined by the aspect; on the windward side of Mauna Kéa it is at a height of nearly twelve thousand feet, while on the lee of Mauna Lòa it is no higher than eight thousand. There is no truly alpine zone; the trees and shrubs of the lower regions become stunted, and finally disappear, and the upper regions are wholly destitute of vegetable life. *Dodonæa, Sophora, Osteomeles, Vaccinium, Gouania orbicularis*, are found near the upper limits. The timber of the forest is largely *Metrosideros*, and *Acacia koa*, while the *Aleurites* is abundant. It is in the dense woods of the lower slopes (three thousand to four thousand feet) that the tree-ferns, and lower still the Lobeliaceæ, the Labiatæ, and the *Cordyline* are found.

"The regions yielding the richest harvest of species lie between fifteen hundred and six thousand feet above the sea. *Drosera longifolia* is found at an elevation of eight thousand feet, many thousand miles from its nearest known habitat. There are but few showy flowers, and still fewer fragrant ones, in the Hawaiian flora. The genera *Hibiscus, Gardenia, Bryonia, Brighamia, Metrosideros, Eugenia, Scævola, Cyrtandra, Phyllostegia*, with a few Compositæ, Convolvulaceæ, and Leguminosæ, comprise nearly all the showy or beautiful flowers. In the colouring, white or greenish-white is predominant, and yellow and pink follow at a respectful distance. There are very few blue flowers. *Strongylodon lucidum* is a rich crimson, and some other leguminous plants are violet, but the various and brilliant colouring of the Californian plants is wholly absent.

[1] An analysis of H. Mann's Enumeration of the Plants, by W. T. Brigham, extracted from the *Proceedings of the Boston Society of Natural History*, xii., 1868. This is reproduced without the modifications necessary to bring it in harmony with Bentham and Hooker's Genera Plantarum; but the alterations would be unimportant. See p. 11, and also p. 19, for the distribution and affinities of the arboreous Compositæ.

"It is a matter of great interest to ascertain the indigenous fruits. The cocoa-nut, pandanus, cordyline, bread-fruit, and kalo, are in the present list regarded as belonging to this class, although many have supposed the natives transplanted them in their migrations, or that oceanic currents drifted them upon the shores. To the former hypothesis the objection presents itself, that the bread-fruit grows on the island only by cuttings, which could not be preserved for so long a voyage as would be required to come from the nearest land,[1] and the kalo (*Colocasia*) does not possess much persistent vitality; to the latter the existing currents would prove an obstacle, as these strike the Hawaiian group from the north-east, bringing huge pine logs from Oregon, but no tropical fruits."

ORDINAL COMPOSITION OF THE FLORA OF THE SANDWICH ISLANDS.

	Genera.	Species.	Endemic. Genera.	Endemic. Species.	Genera of Endemic Species only.	Orders of Endemic Species only.		Genera.	Species.	Endemic. Genera.	Endemic. Species.	Genera of Endemic Species only.	Orders of Endemic Species only.
Amarantaceæ	5	9	2	3	...	...	Menispermaceæ	2	3	...	1	...	...
Anacardiaceæ	1	1	...	...	...	...	Myoporineæ	1	1	1	1	...	*
Apocynaceæ	4	5	...	4	3	...	Myrsineæ	1	3	...	3	1	*
Araliaceæ	6	7	3	7	2	*	Myrtaceæ	3	6	...	2	...	...
Aroideæ	2	2	...	...	...	...	Naiadaceæ	3	5	...	...	...	...
Basellaceæ	1	1	...	...	...	...	Nyctagineæ	2	3	...	...	...	...
Begoniaceæ	1	1	1	1	...	*	Oleaceæ	1	1	...	1	1	*
Bixaceæ	1	1	...	1	1	*	Onagrarieæ	1	1	...	...	...	...
Boraginaceæ	3	4	...	...	...	...	Orchideæ	2	3	1	3	1	...
Capparidaceæ	2	2	...	1	...	...	Palmæ	2	4	1	3	1	...
Caryophyllaceæ	3	14	2	14	1	*	Pandanaceæ	2	2	...	1	1	...
Celastrineæ	1	1	...	1	1	*	Papayaceæ	1	1	...	...	...	...
Chenopodiaceæ	2	5	...	1	...	...	Phytolaccaceæ	1	1	...	...	...	...
Commelinaceæ	2	2	...	...	...	...	Piperaceæ	2	13	...	8	...	...
Compositæ	24	59	6	46	5	...	Pittosporeæ	1	6	...	6	1	*
Convolvulaceæ	6	13	...	5	3	...	Plantagineæ	1	3	...	2	...	...
Cruciferæ	3	4	...	2	1	...	Plumbagineæ	1	1	...	...	...	...
Cucurbitaceæ	3	6	1	4	...	...	Polygonaceæ	2	3	...	1	...	...
Cyperaceæ	14	40	2	22	6	...	Portulaceæ	2	3	...	2	1	...
Dioscoreaceæ	2	2	...	...	...	...	Primulaceæ	1	2	...	1	...	...
Droseraceæ	1	1	...	...	...	...	Ranunculaceæ	1	2	...	2	1	*
Ebenaceæ	1	2	...	2	1	*	Rhamnaceæ	3	7	...	5	1	...
Epacrideæ	1	2	...	...	...	...	Rosaceæ	4	5	1	4	3	...
Ericaceæ	1	2	...	2	1	*	Rubiaceæ	13	33	3	28	5	...
Euphorbiaceæ	7	14	...	8	2	...	Rutaceæ	4	17	2	17	2	*
Gentianaceæ	1	1	...	1	1	*	Santalaceæ	2	3	...	3	2	...
Geraniaceæ	2	6	...	4	1	...	Sapindaceæ	2	3	...	...	...	...
Gesneraceæ	1	14	...	13	1	*	Sapotaceæ	1	1	...	1	1	*
Goodeniaceæ	1	6	...	5	1	...	Saxifragaceæ	1	1	...	1	1	*
Guttiferæ	1	1	...	...	...	...	Scrophulariaceæ	2	2	...	...	...	...
Haloragеæ	1	1	...	1	1	*	Smilacineæ	1	3	...	3	...	...
Hydrophyllaceæ	1	1	...	1	1	*	Solanaceæ	4	12	1	9	1	...
Ilicineæ	1	1	1	1	...	*	Sterculiaceæ	2	3	...	1	...	...
Iridaceæ	1	1	...	1	1	*	Taccaceæ	1	1	...	...	...	...
Juncaceæ	2	2	...	1	...	...	Ternstrœmiaceæ	1	1	...	1	1	*
Labiatæ	4	29	2	28	1	...	Thymelæaceæ	1	6	...	5	...	...
Lauraceæ	2	2	...	1	1	...	Tiliaceæ	1	1	...	1	1	*
Leguminosæ	19	29	...	11	5	...	Umbelliferæ	3	3	...	1	1	...
Liliaceæ	4	5	...	3	2	...	Urticaceæ	11	14	2	8	4	...
Lobeliaceæ	6	35	5	35	1	*	Verbenaceæ	4	4	...	...	...	...
Loganiaceæ	1	5	1	5	...	*	Violarieæ	2	6	1	6	1	*
Loranthaceæ	1	1	...	...	...	...	Zingiberaceæ	2	2	...	...	...	...
Lythrarieæ	2	2	...	...	...	...	Zygophyllaceæ	1	1	...	...	...	...
Malvaceæ	6	16	...	10	...	...	Totals	253	554	39	376	76	26

[1] See S. B. Dole, Voyages of the Ancient Hawaiians. Hawaiian Club Papers, 1868, p. 4.

Taking all the plants, both native and introduced, we have as the proportion of species to each genus,	2·58
To endemic genera alone,	3·94
To genera represented only by endemic species,	1·28
To introduced genera,	1·07
Endemic genera of only one species,	16
Genera of a single endemic species,	49
Introduced genera of one species,	43
Other genera of one species,	45
Percentage of all the endemic species,	68·05
„ „ species of endemic genera,	28·0
„ „ introduced species,	12·46

The grasses were left undetermined by Mann, and are not included in the foregoing figures. About twenty-two species have been recorded, four of which are endemic.

Since the publication of Mann's Enumeration of Hawaiian Plants and the foregoing analysis of it, Dr H. Wawra, who spent four months in the islands during the cruise of the Austrian frigate "Donau," and formed very extensive botanical collections, has made two important contributions to our knowledge of their vegetation, in the Flora for 1872–75, and the Œsterreichische Botanische Zeitung for 1872 and 1873. Judging from a superficial examination, the latter is by far the most complete account of the aspects of the vegetation of the Sandwich Islands in existence; and the former not only contains descriptions of between forty and fifty new species of flowering plants, besides a large number of varieties, but it likewise includes full descriptions of many previously imperfectly known plants. It is singular with this very considerable accession of species there is nothing generically new, for Wawra does not appear to have established critical species. Dr Engler (Versuch einer Entwicklungsgeschichte der Pflanzenwelt, ii. pp. 104–145), has fully tabulated the distribution of all the Sandwich Islands vascular plants with reference to their nearest allies; and he finds that 500, or 74·6 per cent. of the 669 species which he regards as indigenous, are endemic. The vascular cryptogams number 140, whereof 57 are endemic, thus leaving 529 flowering plants, 443 of which are endemic.

A further addition has been made to the number of endemic species in the Sandwich Islands flora in Mr C. B. Clarke's monograph of the Cyrtandreæ,[1] a group of plants widely spread in Polynesia, from which we extract the following particulars of the distribution of this tribe and of the genus *Cyrtandra*, the only one represented in this group.

The Gesnereæ are restricted to America, while the Cyrtandreæ are almost confined to the Old World; the great body of the tribe being situated in South-east Asia, extending from India to Japan and New Guinea; a single genus, *Cyrtandra*, having numerous species scattered through Polynesia to Tahiti and the Sandwich Isles. The Cyrtandreæ may be conceived as nearly continuous over this area, abounding both in variety of forms and number of individuals. External to this area we find only a few small groups,

[1] In De Candolle's Suites au Prodromus Systematis Naturalis Regni Vegetabilis, vol. v. par. 1.

namely: in Europe, one species of *Ramondia* in the Pyrenees, and three species of *Ramondia* and *Haberlea* in the Balkans; in Africa, from the Cape to the Cameroons and Zanzibar and Madagascar, twenty species, of which eighteen belong to the endemic genus *Streptocarpus*; in Australia four species, and in New Zealand one, belonging to the endemic *Rhabdothamnus*. The distribution of the species of *Cyrtandra* is somewhat remarkable, and offers an example of an Old World genus extending to the Sandwich Islands, and there developing numerous forms. Clarke defines 167 species, whereof 151 are endemic, as far as at present known, in a single island or group of small islands as follows:—Penang, 1; Sumatra, 21; Java, 10; Ceram, 1; New Guinea, 4; Halmaheira, 1; Ternate, 1; Celebes, 3; Borneo, 24; Philippine Islands, 6; Ualan, Caroline Islands, 1; New Hebrides, 2; Fijis, 20; Samoa, 9; Tahiti, 11; and the Sandwich Islands, 36. Of the last, 16 appear to be confined to Oahu, 4 to Hawaii, and 7 to Kauai.

THE GALAPAGOS.

The flora of these islands not only contains a large number of species not found elsewhere, but, what is more remarkable, each island of the group has its endemic species of plants; and Darwin states that this feature is almost as strongly developed in the animal kingdom. Andersson's essay[1] on the vegetation of the Galapagos is the latest, and further accentuates this peculiarity, which was first brought to light in Sir Joseph Hooker's elaboration of the collections made by Darwin, Edmonstone, Macrae, and others. He enumerates 332 species of phanerogamous plants; but the group has by no means been exhaustively botanised, some of the islands being apparently still virgin ground. Chatham, Charles, Albemarle, and James, are the islands whence Hooker had collections, and Andersson hastily visited these four islands, as well as Indefatigable. Of the whole number of flowering plants hitherto collected, 158 are common to other regions, while 174, or more than half, are peculiar to the islands; and, excluding evidently introduced species, the proportion of endemic species would be still higher.[2] Taking the endemic species, only five of them are known to occur in all five of the islands named; only two in four of the islands; and only six in three of the islands. Sixteen of the endemic species are found in Chatham and Charles Islands; three in Chatham and Indefatigable; seven in Chatham and Albemarle; four in Chatham and James; two in Charles and Indefatigable; four in Charles and Albemarle; four in Charles and James; and two in James and Albemarle. The numbers of species hitherto collected in only one island are: Charles, 40; James, 27; Chatham, 26; Albemarle, 21; and Indefatigable, 29. Besides these there are three species peculiar to the group, but it is not known in which island or islands they were collected.

[1] Linnæa, xxxi. p. 609 (German translation of the original Swedish).

[2] This would be about counterbalanced by deducting some of the forms treated as species by Andersson which we should regard as varieties.

Here, as in so many Oceanic Islands, woody Compositæ are prominent among the endemic plants. Bentham[1] states that none of the Galapagos Compositæ show any tendency to the arborescent forms observable in the more isolated insular groups, but Andersson says "fifteen of the species are bushy, and several of them reach a height of eight to ten ells, and nearly as much in circumference, thus resembling small trees." What is more definite, he describes *Macræa laricifolia* as "fere biorgyalis," and *Scalesia decurrens* as "bi-triorgyalis;" heights not surpassed by many of the Juan Fernandez and St Helena arboreous members of the same Order. Four or five independent genera of Compositæ have been founded on Galapagos plants, but only two of them are retained in Bentham and Hooker's Genera Plantarum, the others being treated as sections of older genera; and the two retained (*Scalesia* and *Lecocarpus*) might without difficulty, Bentham remarks, have been referred to *Mirasolia* and *Melampodium* respectively. Altogether thirty-eight species of Compositæ are known from the group, and of these twenty-seven are endemic. Other Orders largely represented by endemic species are the Rubiaceæ, Borragineæ, Amarantaceæ, Euphorbiaceæ, and Gramineæ. Only two orchids, an *Epidendrum* and a *Govenia*, have been discovered. The affinities of the endemic element of the flora are entirely American; a very few species have congeners in the Sandwich Islands, such for instance as *Lipochæta laricifolia* (*Macræa*), and not in America; but the singular arboreous Lobeliaceæ of the Sandwich Islands, which have their nearest affinities in America, are wholly wanting. Of the species common to the Galapagos and other countries, Andersson finds that forty-two of them are also found in Africa; forty in India and the Malayan Archipelago; fifteen in Australia; and forty-three are more or less widely spread in Polynesia.

THE SEYCHELLES.

This group consists of upwards of thirty islands, about 900 miles distant from Madagascar, the largest, Mahé, being seventeen miles long, and about 30,000 acres in area, with an altitude of 3000 feet. According to Baker (Flora of Mauritius, Preface, p. 16*), the number of wild flowering plants and ferns then (1877) known to grow in the Seychelles was 338, of which sixty are endemic. Besides the sixty endemic species, between twenty and thirty are characteristic Mascarene types, and the remaining 250 mostly plants of wide dispersion. The composition of the endemic element in the flora of the Seychelles is totally different from that of any other oceanic group, yet it is not less remarkable. Out of the sixty endemic species, fourteen are Rubiaceæ, two are Compositæ, two are Orchideæ, three are *Pandanus*, and six are vascular cryptogams. With the exception of *Medusagyne oppositifolia*, a monotypic genus of the Ternstrœmiaceæ, the endemic genera are all Palmæ. They are: *Lodoicea sechellarum*, *Deckenia nobilis*,[2] *Nephrosperma vanhoutteana*,

[1] *Journal of the Linnean Society of London*, xiii. p. 557.

[2] In Bentham and Hooker's Genera Plantarum, iii. p. 898, *Deckenia* is reduced to the peculiarly Mascarene genus *Acanthophœnix*.

Roscheria melanochætes, Verschaffeltia splendida, and *Stevensonia grandifolia*—five of them distinct monotypic genera. It may be mentioned that the cocoa-nut palm does not exist in a wild state in any of the Mascarene Islands. Shaw (Madagascar and France, 1885, p. 287), says it exists in Madagascar only near the present or former habitations of foreigners.

RODRIGUEZ.

The present flora of this island has been recently investigated by Dr Bayley Balfour, and from his report thereon (Proc. Roy. Soc. Lond., clxviii.) the following particulars were gleaned. Of flowering plants considered as indigenous, there are 175 species, belonging to 119 genera and 57 orders. The monocotyledons number 49 species, a comparatively large proportion. There are 35 endemic species, or one-fifth of the whole, six of them being monocotyledons; 31 species are peculiarly Mascarene; and of the rest 8 are African plants which do not occur in Asia, whilst 14 species are found in Asia, but do not reach Africa. Of the remaining 88, 22 are widely spread in the tropics of the Old World, and 66 are universal tropical weeds. The orders most largely represented in the indigenous flora are: Gramineæ, 21 species; Leguminosæ, 14; Convolvulaceæ, 11; Malvaceæ, 9; Rubiaceæ, Cyperaceæ, and Euphorbiaceæ, each 8; Liliaceæ, 6; Compositæ, and Amarantaceæ, 5 each. A large proportion of the Leguminosæ and Convolvulaceæ are very widely diffused littoral plants, and there is no endemic species of either order. Perhaps the most remarkable feature in this insular flora is the extraordinary heteromorphism in the foliage of many of the shrubby and arboreous species in different stages of their growth. The endemic plants are:[1]—

RUTACEÆ.
Zanthoxylum pinnatum.

MELIACEÆ.
†*Quivisia laciniata.*

ANACARDIACEÆ.
Sclerocarya castanea.

MYRTACEÆ.
Eugenia balfouri.

TURNERACEÆ.
**Mathurina penduliflora.*

RUBIACEÆ.
†*Danais corymbosa.*
Randia heterophylla.
†*Pyrostria trilocularis.*
**Scyphochlamys revoluta.*
Psychotria lanceolata.

COMPOSITÆ.
Psiadia coronopus.
„ *rodriguesiana.*
Abrotanella rhynchocarpa.

LOBELIACEÆ.
Lobelia vagans.

EBENACEÆ.
Diospyros diversifolia.[1]

ASCLEPIADACEÆ.
**Tanulepis sphenophylla.*
Sarcostemma odontolepis.

ACANTHACEÆ.
Hypoestes rodriguesiana.
„ *inconspicua.*

VERBENACEÆ.
Nesogenes decumbens.
Clerodendron laciniatum.

[1] The genera preceded by a * are endemic; and those preceded by a † are peculiarly Mascarene. *Sclerocarya, Psiadia, Listrostachys,* and *Aloe* are African; *Sarcostemma, Hypoestes, Ærua,* and *Pandanus* are confined to the Old World, and the rest are generally dispersed in the tropics.

NYCTAGINEÆ.
Pisonia viscosa.

AMARANTACEÆ.
Ærua congesta.

PIPERACEÆ.
Peperomia hirta.
„ *reticulata.*
„ *rodriguezi.*

EUPHORBIACEÆ.
Euphorbia daphnoides.
Phyllanthus dumetosus.

URTICACEÆ.
Pilea balfouri.

ORCHIDEÆ.
Listrostachys aphrodite.

LILIACEÆ.
Aloe lomatophylloides.

PALMÆ.
†*Latania verschaffelti.*
†*Hyophorbe verschaffelti.*

PANDANEÆ.
Pandanus heterocarpus.
„ *tenuifolius.*

II.—VEGETATION CONTAINING A SMALL, CHIEFLY SPECIFIC ENDEMIC ELEMENT.

MARIANNE ISLANDS, NORTH-WESTERN POLYNESIA.[1]

CAPPARIDACEÆ.
Polanisia viscosa, DC.
Capparis mariana, Jacq.

GUTTIFERÆ.
Calophyllum inophyllum, Linn.

MALVACEÆ.
Hibiscus manihot, Linn.
„ *rosa-sinensis*, Linn.
„ *tiliaceus*, Linn.
Sida glomerata, Cav.
„ *carpinifolia*, Linn. f.
„ *rhombifolia*, Linn.
„ *maura*, Link.[2]

STERCULIACEÆ.
Heritiera littoralis, Ait.
Waltheria elliptica, Cav.

TILIACEÆ.
Triumfetta fabræana, Gaudich.
Corchorus torresianus, Gaudich.

SAPINDACEÆ.
Cardiospermum halicacabum, Linn.
Dodonæa viscosa, Linn.

LEGUMINOSÆ.
Tephrosia mariana, DC.
Desmodium australe, DC.
Mucuna gigantea, DC.
Cassia angustissima, Lam.
Entada pursætha, DC.
Inga javana, DC.

RHIZOPHOREÆ.
Bruguiera gymnorhiza, Lam.

COMBRETACEÆ.
Terminalia moluccana, Lam.
Laguncularia hænkei, Endl.
„ *purpurea*, Gaudich.

MYRTACEÆ.
Psidium pomiferum, Linn.

[1] Extracted without alterations from Endlicher's Synopsis Floræ Insularum Oceani Australis. It will be seen that a large number of the plants are the same as are found in the South-eastern Moluccas and the Admiralty Islands, and many of the names stand as synonyms in this work. Very few of the species described as new from these islands by Gaudichaud, Presl, De Candolle, and others, are represented by authenticated specimens in the London Herbaria, therefore we are unable to estimate the endemic element; but, so far as the flora is known, this element is limited to species.

[2] "*Sida maura*, Link," does not occur in the work cited by Endlicher, nor do we find it elsewhere. Probably it should have been *Sida mauritiana*, a synonym of *Abutilon indicum*, which is very widely dispersed in the tropics of the Old World.

Barringtonia speciosa, Linn. f.
„ *racemosa*, Gaudich.

MELASTOMACEÆ.

Medinilla rosea, Gaudich.

LYTHRARIEÆ.

Ammannia octandra, Linn.
Pemphis acidula, Forst.

RUBIACEÆ.

Geophila reniformis, Cham. et Schlecht.
Mitrocarpum torresianum, Cham. et Schlecht.

COMPOSITÆ.

Vernonia chinensis, Less.
Elephantopus carolinianus, Willd.
Distreptus spicatus, Cass. = *Elephantopus*.
Adenostemma viscosum, Forst.
Glossogyne tenuifolia, Cass.
Eclipta erecta, Linn.
Wedelia chamissonis, Less.
Verbesina? argentea, Gaudich.
Artemisia vulgaris, Linn.

LOBELIACEÆ.

Scævola kœnigii, Vahl.

APOCYNACEÆ.

Alyxia torresiana, Gaudich.

BORAGINACEÆ.

Carmona heterophylla, Cav. = *Ehretia*.
Heliotropium zeylanicum, Lam.
Tiaridium indicum, Lehm. = *Heliotropium*.
Tournefortia argentea, Linn.

CONVOLVULACEÆ.

Ipomœa maritima, R. Br.

SOLANACEÆ.

Physalis lanceifolia, Nees.
Lycopersicum cerasiforme, Dun.

SCROPHULARINEÆ.

Limnophila gratioloides, R. Br.
„ *serrata*, Gaudich.

VERBENACEÆ.

Vitex incisa, Lam.
Premna integrifolia, Linn.

LABIATEÆ.

Ocimum canum, Sims.
„ *sanctum*, Linn.
Hyptis capitata, Jacq.
„ *pectinata*, Poir.

NYCTAGINEÆ.

Boerhaavia hirsuta, Linn.

AMARANTACEÆ.

Amarantus spinosus, Linn.

POLYGONACEÆ.

Polygonum barbatum, Willd.

PIPERACEÆ.

Piper betel, Linn.
„ *potamogetonifolium*, Opiz.
„ *marianum*, Opiz.

EUPHORBIACEÆ.

Phyllanthus niruri, Linn.
Euphorbia pilulifera, Linn.

URTICACEÆ.

Bœhmeria paniculata, Endl.
Procris candolleana, Gaudich.
„ *nivea*, Gaudich.
„ *torresiana*, Endl.
„ *divaricata*, Endl.

CYCADACEÆ.

Cycas circinalis, Linn.

HYDROCHARIDEÆ.

Halophila ovata, Gaudich.

ORCHIDEÆ.

Cymbidium triste, Willd.
Limodorum fasciola, Swartz.
Nervilia arragoana, Gaudich. = *Pogonia*.
„ *ovata*, Gaudich.

SCITAMINEÆ.

Canna indica, Ait.
Zingiber zerumbet, Rosc.
Musa textilis, Nees.

COMMELINACEÆ.

Commelina spp.

PALMÆ.

Areca oleracea, Linn.?

NAIADACEÆ.

Potamogeton gaudichaudii, Cham.
„ *fluitans*, *a. mariannensis*, Cham.

CYPERACEÆ.

Cyperus pennatus, Lam.
„ *difformis*, Linn.
Kyllinga monocephala, Rottb.
Fuirena umbellata, Rottb.
Fimbristylis puberula, Vahl.
„ *marianna*, Gaudich.
„ *littoralis*, Gaudich.
„ *pilosa*, Vahl.
„ *affinis*, Presl.
„ *torresiana*, Gaudich.
Isolepis miliacea, Presl.
„ *willdenowii*, Roem. et Schult.
Eleocharis plantaginea, Roem. et Schult.
„ *atropurpurea*, Presl.
Rhynchospora aurea, Vahl.
Baumea mariscoides, Gaudich. (*Cladium*).
Carex fuirenoides, Gaudich.
„ *compacta*, Presl.

GRAMINEÆ.

Paspalum orbiculare, Forst.
„ *cartilagineum*, Presl.
Panicum subquadriparum, Trin.
„ *gaudichaudii*, Kunth.
Isachne minutula, Kunth.
Oplismenus colonus, Humb. et Kth.
Setaria glauca, Beauv.
Dactyloctenium ægyptiacum, Willd.
Bambusa arundinacea, Willd. ?
Poa tenella, Linn.
Centotheca lappacea, Desv.
Haplachne pilosissima, Presl = *Dimeria*.
Andropogon chloridiformis, Gaudich.

Kittlitz gives three views of the vegetation of Guam or Guaham, one of the Marianne Islands, in which the genera *Cycas*, *Casuarina*, *Ficus*, *Pandanus*, *Cordia*, *Cerbera*, *Terminalia*, *Artocarpus*, *Barringtonia*, *Hernandia*, *Thespesia*, and *Calophyllum* are conspicuous.

ELIZABETH ISLAND. (About 128° W. long., and 24° S. lat.)[1]

Guettarda speciosa, *Cephælis fragrans* (Bot. Beech. Voy., t. 13), *Tournefortia argentea*, and *Euphorbia ramosissima* were collected by Beechey and Cuming on this island. The latter also collected a few ferns, and one or two doubtful flowering plants. *Cephælis fragrans* (*Ixora?*) is only known from Elizabeth Island.

EASTER ISLAND. (About 109° W. long., and 27° S. lat.)

Endlicher enumerates the following plants from Easter Island :—

Sapindus saponaria, Forst.
Thespesia populnea, Corr.
Lagenaria vulgaris, Ser.
Samolus littoralis, R. Br.
Curcuma longa, Linn.
Lepturus repens, R. Br.
Deyeuxia chamissonis, Kunth.
„ *forsteri*, Kunth.
Agrostis conspicua, Willd.
Paspalum filiforme, Sw.

A few other plants, including *Sophora tetraptera*, *Sesuvium portulacastrum*, and other equally widely spread plants, have been collected in the island. There may be a fuller representation of the vegetation of this and other islands of Eastern Polynesia in the old collections at the British Museum, but it hardly came within the scope of this

[1] These are mere rough approximations, taken from one of Stanford's large educational maps, to give the reader an idea of the positions of the islands.

work to look up the plants. We know, however, from Captain Cook's description of the island, that wood is wanting altogether; his party on two excursions met with only two or three shrubs, one of them, from the description, doubtless *Sophora*. The generally diffused large Polynesian tree *Metrosideros polymorpha*, which is found in Pitcairn and Elizabeth Islands, and forms extensive forests in some of the groups, especially in the Sandwich Islands, seems to be absent.

III.—VEGETATION CONTAINING NO ENDEMIC ELEMENT.

ISLANDS OF THE INDIAN OCEAN.

List of Plants in the Kew Herbarium collected in some of the smaller Tropical Islands by Dr Coppinger.[1]

Cleome (§ *Polanisia*) *strigosa*, Oliv. Du Lise Island, Gloriosa group.
Portulaca oleracea, Linn. Bird Island, Seychelles group.
Portulaca quadrifida, Linn. Eagle Island, Amirante group, Du Lise Island.
Calophyllum inophyllum, Linn. Isle des Roches, Amirante group.
Sida carpinifolia, Linn. f. Providence Island, Mascarene group.
Sida spinosa, Linn. Du Lise Island, Isle des Roches, Cerf Islet (No. 1), Providence Reef.
Abutilon indicum, Don. Bird Island, Providence Island, Isle des Roches.
Hibiscus hornei, Baker. Du Lise Island.
Thespesia populnea, Corr. Du Lise Island.
Triumfetta procumbens, Forst. Providence Island, Isle des Roches.
Tribulus terrestris, Linn. Eagle Island, Amirante group.
Sesbania aculeata, Pers. Bird Island, Eagle Island.
Cassia occidentalis, Linn. Providence Island.
Desmanthus virgatus, Willd. Providence Island.
Pemphis acidula, Forst. Du Lise Island, Poivre Island, Amirante group.
Suriana maritima, Linn. Bird Island, Cerf Islet (No. 3), Providence Reef, Isle des Roches.
Carica papaya, Linn. Providence Island.
Cucumis trigonus, Roxb. Du Lise Island.
Morinda citrifolia, Linn. Isle des Roches.
Guettarda speciosa, Linn. Poivre Island.
Vernonia cinerea, Less. Isle des Roches.
Tridax procumbens, Linn. Isle des Roches.
Scævola kœnigii, R. Br. Isle des Roches.
Ochrosia borbonica, Gmel. Providence Island, Alphonse Island, Mascarene group.
Cordia subcordata, Lam. Du Lise Island.
Tournefortia argentea, Linn. f. Bird Island, Cerf Islet (No. 1), Providence Reef, Poivre Island.
Ipomœa grandiflora, Lam. (non Roxb.)
„ *glaberrima*, Bojer. Providence Island, Du Lise Island.
Solanum nodiflorum, Jacq. Du Lise Island.
Physalis angulata, Linn. Du Lise Island.
Datura alba, Nees. Isle des Roches.
Striga hirsuta, Lour. Providence Island, Isle des Roches.
Boerhaavia diffusa, Linn. Du Lise Island, Providence Island.
Achyranthes aspera, Linn. Eagle Island.
Amarantus caudatus, Linn. Providence Island, Eagle Island.
Amarantus retroflexus, Linn. Providence Island.
Hernandia peltata, Meissn. Alphonse Island, Providence Island.
Cassytha filiformis, Linn. Isle des Roches, Providence Island.
Euphorbia pilulifera, Linn. Providence Island.
„ *prostrata*, Ait. Du Lise Island, Providence Island.
Ficus nautarum, Baker. Alphonse Island.
Pipturus argenteus, Wedd. Isle des Roches.

[1] For lists of plants from the Cocos and Chagos Islands, see Part III., pp. 113–115.

Fleurya æstuans, Gaud. Eagle Island, Providence Island.
Casuarina equisetifolia, Forst. Poivre Island.
Cyperus ligularis, Linn. Eagle Island, Providence Island.
Cyperus rotundus, Linn. Du Lise Island.
Fimbristylis glomerata, Nees. Providence Island.
Setaria glauca, Beauv. Gloriosa Island.
Eleusine ægyptiaca, Pers. Bird Island, Providence Island, Eagle Island.
Eragrostis tenella, Beauv. Du Lise Island.
Nephrolepis exaltata, Schott. Isle des Roches.

Summary.

Du Lise Island, Gloriosa group	15 species.	Cerf Islets, Providence Reef	4 species.
Bird Island, Seychelles group	6 „	Poivre Island, Amirante group	4 „
Eagle Island, Amirante group	8 „	Alphonse Island, Mascarene group	3 „
Isle des Roches, Amirante group	14 „	Gloriosa Island	1 „
Providence Island, Mascarene group	20 „		

The majority of the plants in the foregoing list are very widely spread, and details of their distribution will be found in the geographical tables and lists in Part III., pp. 107–117, and pp. 232, 233; but there are a few exceptions, which are interesting as indicating a probable former closer connection of the islands of this region. They are appended with their distribution :—

Cleome (*Polanisia*) *strigosa*	Island of Zanzibar and Mozambique.
Hibiscus hornei	Praslin Island, Seychelles : endemic.
Ochrosia borbonica	Mauritius, Seychelles, Bourbon.
Ficus nautarum	Seychelles.

SMALLER PACIFIC ISLANDS.[1]

Marshall Islands (North-western Polynesia).

To the Berliner Gartenzeitung of 1884, E. Betche contributes a sketch of the Vegetation of the Marshall Islands, where he spent six weeks, but succeeded in finding only fifty-six species of plants, though he visited six of the Atolls. He mentions the following :—

Calophyllum inophyllum.
Triumfetta sp.
Pemphis acidula.
Terminalia sp.
Barringtonia speciosa.
Morinda citrifolia.
Scævola kœnigii.
Cerbera sp.
Tabernæmontana.
Tournefortia argentea.
Cassytha sp.
Hernandia peltata.
Tacca sp.
Pandanus odoratissimus.
Thouarea sp.

Maldon Island. (About 155° W. long., and 4° S. lat.)

Among the unpublished lists of plants from various parts of the world, in the Kew Herbarium, is the following by Sir Joseph Hooker. They were collected by James Macrae,

[1] For lists of plants from a number of other Pacific Islands, see Part III., p. 116.

who travelled for the Horticultural Society of London, from 1824 to 1826, and visited among other places Maldon, the Sandwich, and one of the Galapagos Islands.

Lepidium piscidium, Forst.
Portulaca oleracea, Linn.
Talinum patens, Linn.
Sida, near *Sida cordifolia*.
Oxalis corniculata ?
Tribulus cistoides, Linn.
Crotolaria sp.
Pemphis acidula, Forst.
Metrosideros obovata, Hook.
Coprosma sp.
Guettarda sp.
Pisonia sp.
Boerhaavia hirsuta, Linn. ?
Achyranthes velutina, H. and A.

List of Plants Collected in Caroline Island (150° *W. long., and* 10° *S. lat.*) *in* 1884 *by Dr Dixon, U.S.N.*[1]

This list, it is stated, comprises the entire flora of the island. Cultivated as well as wild plants are included in the original list, but the following are all the wild vascular ones it contains :—

Lepidium piscidium, Forst.
Portulaca (two varieties).
Calophyllum inophyllum, Linn.
Sida fallax, Walp.
Suriana maritima, Linn.
Morinda citrifolia, Linn.
Cordia subcordata, Lam.
Tournefortia argentea, Linn. f.
Heliotropium anomalum, Hook. and Arn.
Boerhaavia sp.
Pisonia grandis, R. Br.
Euphorbia pilulifera, Linn.
Phyllanthus niruri, Linn.
Fleurya ruderalis, Gaud.
Pandanus sp.
Cocos nucifera, Linn. (cult.)
Panicum marginatum ? R. Br.
Eleusine indica, Gærtn.
Eragrostis plumosa, Link.
Lepturus repens, R. Br.
Polypodium phymatodes, Linn.

Pitcairn Island. (About 130° W. long., and 25° S. lat.)

This island was visited by Captain Beechey, and there are specimens of a few plants in the Kew Herbarium collected there by Cuming and others ; among them *Hibiscus tiliaceus, Osteomeles anthyllidifolia*,[2] *Metrosideros polymorpha, Morinda citrifolia, Guettarda*

[1] Memoirs of the National [American] Academy of Sciences, ii. 1884, p. 88. This island must not be confounded with the Caroline Archipelago in North-western Polynesia, concerning the botany of which almost nothing is known, though it has been visited by one Russian, and at least one French exploring expedition. Endlicher enumerates only the following seven plants—*Paspalum reimarioides*, Brongn. ; *Eleusine indica*, Gærtn. ; *Lepturus repens*, R. Br. ; *Saccharum insulare*, Brongn. ; *Centotheca lappacea*, Desv. ; *Ischæmum intermedium*, Brongn. ; *Cycas circinalis*, Linn.—three of which are described as endemic. Kittlitz gives four views of the vegetation of Ualan, and two of Lugunor, islands of this archipelago. The plants represented include the common Polynesian species of such genera as *Thespesia, Pandanus, Cordyline, Cocos, Scævola, Tournefortia, Hibiscus, Calophyllum, Barringtonia, Artocarpus, Guettarda*, and *Tacca ;* and one of the larger trees is said to be a species of *Myristica*.

[2] *Osteomeles* is an outlying genus of Rosaceæ Pomeæ, of which there are about eight or ten species, inhabiting the Andes, and *Osteomeles anthyllidifolia*, which is restricted to Polynesia. This was first collected in the Sandwich Islands by Menzies, and the genus was founded upon it (Lindley in *Trans. Linn. Soc. Lond.*, xiii. p. 98, t. 8).

speciosa, *Cerbera odollam*, *Solanum* sp., *Achyranthes* sp., *Broussonetia papyrifera*, and a few common grasses. We also learn from Beechey's narrative that the Ti (*Cordyline* sp.) grew there; and in a view of the interior of the island in the same work, a large fig-tree is represented amidst cocoa-nut palms.

EXAMINATION OF SOME OF THE SPECIAL FEATURES OF INSULAR FLORAS.

ENDEMIC ARBOREOUS AND SHRUBBY COMPOSITÆ IN OCEANIC ISLANDS.[1]

The Sandwich Islands.

Genera.	Number of Species.	Sub-order.	Affinities of Genus or Species.	Distribution of Genus.
Tetramolopium	6	Asteroideæ	South extra-tropical American	Endemic.
Lipochæta . .	10	Helianthoideæ	Chiefly American	One species in the Galapagos.
Dubautia . .	3	Helianthoideæ	Mexican	Endemic.
Wilkesia . .	1	Helianthoideæ	Mexican	Endemic.
Raillardia . .	11	Senecionideæ	Mexican	Endemic.
Hesperomannia	1	Mutisiaceæ	Brazilian	Endemic.

Few of the woody Compositæ of the Sandwich Islands are really arboreous in habit and stature, the majority being shrubs, some of them of quite small dimensions. *Raillardia arborea*, A. Gr., and *Hesperomannia arborescens*, A. Gr., are, however, really arboreous, having trunks twenty feet high. The latter is remarkable as the only member of the Mutisiaceæ found in Polynesia proper. Mann states in his Catalogue of the Plants of the Sandwich Islands that only one tree was seen, and that on the summit of Lanai, at about 2500 feet elevation; but Wawra has since collected it sparingly on Waianæ in Oahu.

The Galapagos Islands.

Mr Bentham states (*loc. infr. cit.*, p. 537) that none of the Galapagos Compositæ show any tendency to the arborescent forms observable in the more isolated insular groups; this,

It is the only one with pinnate leaves, and is thus of very different aspect from the Andine species. Besides Cuming's Pitcairn Island specimen, and numerous specimens from the Sandwich Islands, there are in the Kew Herbarium two or three from the Bonin Islands, and one from Maingaia (about 157° W. long., and 22° S. lat.), so that it practically ranges across the Pacific. The haw-like fruit is described as being of a pleasant flavour.

[1] Compiled largely from Mr Bentham's Notes on the Classification, History, and Geographical Distribution of the Compositæ, with particulars of their dimensions from various sources: *Journal of the Linnean Society of London*, xiii. pp. 554–568.

however, as we have explained on p. 11, is hardly correct, for Andersson describes *Macræa laricifolia*, Hook. f. (*Lipochæta*, A. Gr., Helianthoideæ), as "fere biorgyalis," and *Scalesia decurrens*, Anders. (Helianthoideæ), as "bi-triorgyalis"—dimensions exceeded by only a small proportion of the woody Compositæ in other oceanic islands. There are, according to Andersson, fifteen bushy Compositæ in the Galapagos, several of them reaching a height of eight to ten ells.

The Islands of the South Pacific.

The islands of the South Pacific, from the Fijis to the Marquesas, are exceedingly poor in Compositæ, and the only genus of special interest is *Fitchia* (Helianthoideæ), concerning which Bentham (*loc. cit.*, p. 558) says: "Lastly, there is the very remarkable *Fitchia*, found once only, I believe, in each of two different South Sea Islands,[1] and systematically connected with none but the Juan Fernandez *Dendroseris*.[2] Of the whole nineteen or twenty Compositæ [in the South Pacific Islands] this will probably prove to be the only one presenting a remnant of the ancient flora, the only exception to the more or less adventitious character of the South Pacific Compositæ."

Fitchia nutans, Hook. f., is a veritable tree, attaining a height of twenty-five feet.

[1] It is doubtful whether *Fitchia* was collected in Elizabeth Island by Cuming, upon whose specimen, thus labelled, the genus was founded (Hooker's *London Journal of Botany*, iv., 1845, p. 640, t. 23). The label, it is true, bears the name of this island; but we doubt its correctness, because in a manuscript list, of which there are two copies in the Kew library, there is no Compositæ among the numbers included under Elizabeth Island. The number 1424, attached to both the Benthamian and Hookerian specimens of *Fitchia nutans* in the Kew Herbarium, is in Cuming's list under Toubouia or Tubai Island, some twenty-two degrees west of Elizabeth Island. Whether it was actually collected in the last-named island or in Tahiti, where Cuming also collected on the same voyage, is a little uncertain, inasmuch as it has since, as far as we are aware, only been collected in Tahiti. Seemann (Flora Vitiensis, p. 109) questions the accuracy of Cuming's Elizabeth Island locality.

[2] The opposite leaves, paleaceous receptacle, and biaristate achenes point to the Helianthoideæ rather than the Cichoriaceæ, in spite of all the florets being ligulate. By some mischance the generic character in Bentham and Hooker's Genera Plantarum is incorrect and contradictory in some particulars. Nadeaud (Énumération des Plantes Indigènes de l'Ile de Tahiti, p. 49), seems to have had copious specimens under observation, and he expresses the same opinion, in which, he says, he was supported by the eminent botanist, Mr J. E. Planchon, to whom he showed his specimens. Nadeaud suggests the vicinity of *Bidens*, or *Wedelia* and *Wollastonia*, as the systematic position of *Fitchia;* but apart from its habit and ligulate flowers it is not materially different from the St Helena helianthoid *Petrobium arboreum*, R. Br. (*Bidens arborea*, Roxb.), and certainly nearer to it than the other genera named.

A second species (*Fitchia tahitiensis*) is described by Nadeaud. It is a shrub six to twelve feet high, growing in large clumps in various parts of the island, at elevations of between 800 and 1000 metres. And with regard to *Fitchia nutans*, he states that it is spread over nearly all the high summits of the island above an elevation of a thousand metres. This deserves repeating, because the prevalent idea is that this tree is extremely rare. Professor Dana, of the United States South Pacific Exploring Expedition, collected a single specimen of it, according to Gray (Proc. Amer. Acad., v. p. 146), in the mountains of Tahiti, though its rarity is not adduced as the reason. Mr Moseley, however, on a label attached to a specimen in the Kew Herbarium, collected by him in the same island at an altitude of about 4000 feet, states that only one tree was seen, and that was about twenty-five feet high, with a stem nine inches in diameter.

Canary Islands and Madeira.

The Compositæ number about 150 species, whereof half are endemic. Bentham (*loc. cit.*, p. 563) says :—" The insular tendency to a more shrubby form than their continental congeners or allies is also exhibited in *Allagopappus, Vieræa, Gonospermum, Chrysanthemum, Senecio,* and *Sonchus ;* but there is nothing of the arborescent or highly differentiated character of the *Petrobium* of St Helena, of the *Dendroseris* and others of Juan Fernandez, or of the *Fitchia* of the South Sea Islands."

In this comparison, as in that concerning the Galapagos Compositæ, Bentham seems to have entertained an exaggerated idea of the stature of the St Helena and Juan Fernandez woody members of the order. As already mentioned, Bertero gives the height of three of the larger species of *Dendroseris* as ten to fifteen feet. Two or three of the Madeiran and Canary Island species of *Sonchus,* a genus of the same suborder as *Dendroseris,* attain to about the same size. Thus *Sonchus fruticosus,* Linn. f., is described by Lowe (Manual of the Flora of Madeira, i. p. 552) in the following words :— " Almost subarborescent, and gigantic in all its parts, being from four or five to ten or twelve feet high, with a trunk often as thick as the arm, and the ultimate branches as thick as the forefinger, ending in large spreading or radiating tufts of leaves." The habit of the species of *Dendroseris* represented in Guillemin's Archives de Botanique, i. t. 9, from Gay's drawings, executed in Juan Fernandez, agrees exactly with the foregoing description. *Sonchus arboreus,* DC., a Canary Island species, attains similar dimensions ; and *Senecio kleinia,* Schulz Bip., from the same group, equally deserves the appellation " arboreous ; " while several of these find their counterparts among the dwarfer species of *Dendroseris,* &c. Finally, *Centaurea arborea,* Webb, is described as "*Frutex speciosissimus, 12-pedalis.*"

St Helena.

Genera.	Number of Species.	Suborder.	Affinities of Genus or Species.	Distribution of Genus.
Commidendron	4	Asteroideæ	Andine and Australasian	Endemic.
Melanodendron	1	Asteroideæ	Andine and Australasian	Endemic.
Psiadia . . .	1	Asteroideæ	African	Africa, Mascarene Islands.
Petrobium . .	1	Helianthoideæ	Andine and Chilian	Endemic.
Senecio . . .	2	Senecionideæ	African and Australasian species	General.

In regard to size, if not in height, a few of the larger of the arboreous Compositæ of St Helena considerably surpass those of the islands already considered ; although, as we

shall presently show, they by no means equal some insular species and many continental ones. At p. 54 of Part II. the extreme heights that we have found for each species are given, and the maximum is twenty feet; and only three of them attain even this height. It is quite probable, however, that the trees forming the dense woods of former times were considerably larger.

Juan Fernandez and Masafuera.

Genera.	Number of Species.	Suborder.	Affinities of Genus or Species.	Distribution of Genus.
Rhetinodendron .	1	Senecionideæ	With the Sandwich Island *Raillardia*	Endemic.
Robinsonia . . .	6	Senecionideæ		Endemic.
Dendroseris . .	7	Cichoriaceæ	Not closely allied to any genus.	Endemic.

Although these Compositæ are arboreous in habit, they are no more than miniature trees, the extreme height of the tallest of them not exceeding twenty feet, we believe; and the average height of three of the larger species of *Dendroseris* is, or rather was—for some of them are exceedingly rare if not extinct—according to Bertero, ten to fifteen feet. We have treated *Dendroseris* as endemic, but there are imperfect specimens at Kew of what may be a species of this genus from San Ambrosio. In addition to the genera named above, there is a woody endemic species of the widely-spread genus *Erigeron*, closely resembling a Bermudan endemic species. It is remarkable that the Mutisiaceæ, which constitute more than a third of the numerous Chilian Compositæ, are not represented in Juan Fernandez, while the only member of this suborder hitherto collected in the Pacific Islands is the Sandwich Island arboreous *Hesperomannia*.

Chatham Islands.

Of the six or seven certainly indigenous Compositæ in these islands, three are woody, and two of them trees of considerable size. *Eurybia traversii*, F. Muell., an outlier of a large Australasian genus of Asteroideæ, differing very little structurally from *Aster* itself, to which Mueller has recently reduced it, is a handsome tree, from thirty to thirty-five feet high, with a trunk often four feet in girth, but almost always hollow, a character it has in common with the Australian arboreous *Eurybia argophylla*. *Eurybia traversii* is generally distributed through the woods of the Chatham Islands, though most abundant near the sea. The second arboreous species, *Senecio huntii*, F. Muell., is a tree often attaining a height of twenty-five feet; it is rare in Chatham Island, but common in Pitt Island.

New Zealand.

At least a quarter of the New Zealand Compositæ are shrubby or arboreous, and these all belong to the Asteroideæ and Senecionideæ. In Hooker's Handbook of the New Zealand Flora, fourteen species are described as trees, namely, *Olearia* (*Eurybia*), 11 species; *Senecio*, 2; and *Brachyglottis*, 1. Besides these, one species of *Cassinia* is said to grow fifteen, and another ten feet high. These numbers do not include the Chatham Islands species referred to above, as they were unknown at the date of the Handbook. Dimensions of only a few are given in the descriptions; but *Olearia dentata*, *Olearia cunninghami*, and *Brachyglottis repanda*, are all credited with a height of twenty feet. Further, Mr D. Petrie (Transactions of the New Zealand Institute, xiii. p. 327) describes *Olearia colensoi* as attaining the dimensions of a tree, often having a stem as much as a foot in diameter. In the Transactions of the New Zealand Institute, i. p. 35, we find the following dimensions of arboreous and subarboreous Compositæ, as they grow in the neighbourhood of Otago, contributed by Mr J. Buchanan: *Olearia operina*, trunk six to eight inches in diameter; *Olearia nitida*, twelve to eighteen inches in diameter; *Olearia dentata*, two to three feet in diameter; and *Olearia ilicifolia*, similar to the last. The measurements of *Olearia dentata* especially, indicate a tree of considerable size. Mr Bentham (*loc. cit.*, p. 568) remarks of the New Zealand Compositæ that "some of the genera present highly developed shrubby species, but none so arborescent as in some of the preceding more perfectly isolated island groups;" yet the dimensions we are able to give of a small proportion of the arboreous species equal at least, if they do not exceed, those of the largest in St Helena, Juan Fernandez, &c. New Zealand may be regarded as intermediate in physical conditions between those remote islands and continental areas, though still possessing more of the character of the former than the latter.

Madagascar.

Madagascar is still less insular in character than New Zealand, being both larger and much nearer to a continent; yet shrubby and arboreous Compositæ abound, some of the largest in the world inhabiting this country. During the last few years our knowledge of the Madagascar flora has been considerably increased by the publication of numerous new plants by Dr Baillon in France, and also by Mr J. G. Baker in England. Mr Baker informs us that the novelties include at least forty shrubby and arboreous Compositæ, and that about half of the Compositæ of the country are woody. It will be sufficient for our purpose to give a few examples of the truly arboreous species. Thus, *Synchodendron ramiflorum* (Inuloideæ) grows at least forty feet high, and *Vernonia fuscopilosa* (Vernoniaceæ) is described as a tree thirty to forty feet high, while several other species of the latter genus are designated trees without any dimensions being given.

MAURITIUS, SEYCHELLES, AND RODRIGUEZ.

Genera.	Number of Species.	Suborder.	Affinities of Genus or Species.	Distribution of Genus.
Vernonia	2	Vernoniaceæ	African species	Wide.
Cylindrocline	1	Inuloideæ	Asiatic and African	Endemic.
Monarrhenus	2	Inuloideæ	Asiatic and African	Endemic.
Psiadia	3	Asteroideæ	African species	Africa, Madagascar, St Helena.
Faujasia	3	Senecioideæ	African *Senecio*	Endemic.
Senecio	3	Senecionideæ	African species	Wide.

None of the woody species of these islands attains the dimensions, or assumes the habit even, of a tree; the tallest is *Senecio appendiculatus*, DC., which is described as a shrub six to ten feet high; but these woody species constitute about half of the Compositæ which can be regarded as certainly indigenous. *Psiadia rodrigueziana*, Balf. f. (Botany of Rodriguez, p. 50), is endemic in Rodriguez, where it is now very rare, though "it must have existed formerly in great abundance, as the limestone plains are in many places thickly strewn with fragments of branches and stems."

CONTINENTAL ARBOREOUS COMPOSITÆ.

Large shrubby Compositæ are so numerous in many continental regions that it is sufficient to indicate such genera as *Vernonia*, in Tropical Asia, Africa, and America; *Eupatorium* and *Baccharis*, especially in South America; *Olearia* in Australia; *Helichrysum* and allies in Africa, South India, and Australia, and *Senecio* in various regions. In Australia especially, shrubby Compositæ form a conspicuous feature in the vegetation. In South Africa and Brazil they are also very numerous, though on the whole of smaller dimensions than the Australian. Still arboreous species are wanting neither in Asia, Africa, South America, nor Australia. A few examples are given of truly arboreous species from various regions; and these might be doubled or trebled, but they are sufficient to give an idea of the wide distribution of arboreous Compositæ, and to prove that there are many continental species of larger dimensions than the insular ones.

AUSTRALIA.

Name.	Suborder.	Extreme Height.
Olearia argophylla	Asteroideæ	60 feet.
Eurybia lirata	„	30 „
Helichrysum diosmifolium	Inuloideæ	20 „
Bedfordia salicina	Senecionideæ	30 „

AFRICA.

Name.	Suborder.	Extreme Height.
Vernonia, various species	Vernoniaceæ	25 feet.
Tarchonanthus camphoratus	Inuloideæ	20 „
Brachylæna discolor	„	20 „
Senecio, various species	Senecionideæ	20 „

INDIA.

Name.	Suborder.	Extreme Height.
Vernonia, various species	Vernoniaceæ	20 feet.

SOUTH AMERICA.

Name.	Suborder.	Extreme Height.
Vanillosmopsis arborea	Vernoniaceæ	30 feet.
Vernonia, various species	„	20–40 „
Piptocarpha axillaris	„	30 „
„ *macropoda*	„	70 „
„ *rotundifolia*	„	30 „
Lychnophora, various species	„	"arbores."
Eremanthus incanus	„	40 feet.
Stifftia, various species	Mutisiaceæ	"arbores."
Eupatorium angulicaule	Eupatoriaceæ	18 feet.
Espeletia neriifolia	Helianthoideæ	15 „
Montanoa excelsa	„	40 „
„ *moritziana*	„	30 „

Some particulars respecting continental counterparts of the insular arboreous genera belonging to other orders are given in Part III., p. 23; and a few pages forward is a paragraph on the woody plants of oceanic islands.

LARGE AND ALMOST UBIQUITOUS NATURAL ORDERS ABSENT OR VERY RARE IN OCEANIC ISLANDS.

In spite of the fact that there is a relatively large ordinal and generic element in Oceanic Floras, it is not surprising that many large and widely spread orders are wholly unrepresented in consequence of the small areas involved; still the total absence, or great rarity, of certain almost ubiquitous orders is remarkable and not easily explained. Thus the Leguminosæ, which in numbers stand next to the Compositæ, and reach the utmost limits of phanerogamic vegetation, both latitudinal and altitudinal, are wanting in a large number of oceanic islands where there is no truly littoral flora. In St Helena, for example, there is not a single certainly indigenous species. It is true, Melliss hazards the assertion respecting *Psoralea pinnata* that "doubtless this plant existed in the island on its discovery," and Roxburgh classes it as indigenous; but Forster, who botanised the island about a quarter of a century before the latter, records only *Psoralea aphylla*, a very distinct species from *Psoralea pinnata*, and remarks that it was probably introduced.

Both Burchell and Melliss record the casting ashore of the seeds of various Leguminosæ (see Part II., p. 80) in St Helena, some of which occasionally germinate; yet, in consequence of the nature of the shore being unfavourable, they fail to establish themselves. Furthermore, not a single species of Leguminosæ is native in any of the islands of the southern Atlantic and Indian Oceans, from the Tristan da Cunha group to Amsterdam, the Macdonald group, and the outlying islands of New Zealand, if we except the problematical existence of *Sophora tetraptera* in the Chatham Islands (Mueller, Vegetation of the Chatham Islands, p. 13). In New Zealand itself native Leguminosæ are rare, and form a very insignificant part of the vegetation: only five or six genera exist, and about fifteen species, mostly belonging to the anomalous genus *Carmichaelia*. Passing on to Juan Fernandez, we there find only the widely dispersed and variable *Sophora tetraptera;* yet Leguminosæ abound in Tasmania and Chili (though absent from the Falklands and south of Magellan Strait), and introduced species flourish wherever strewn on the islands. This want of, or poverty in Leguminosæ, is less apparent in the Polynesian groups, the Galapagos, and the equatorial groups in the Indian Ocean. Nevertheless, endemic genera are unknown, and endemic species are few or altogether wanting. There are no endemic species either in Rodriguez or the Seychelles, and only one, *Acacia heterophylla*, is restricted to the Mauritius and Bourbon; and this is remarkable as being one of the very few phyllodineous Acacias outside of Australia, and also on account of being so closely allied to the endemic Sandwich Island *Acacia koa*, that Bentham (Trans. Linn. Soc. Lond., xxx. p. 482) doubts whether the two forms should be admitted to specific rank. The more remote Pacific Islands possess a few peculiar species associated with others of almost world-wide distribution; and eleven out of twenty-nine species found in the Sandwich Islands are regarded as endemic by Brigham; but this number is almost certainly too high. Thirty species of Leguminosæ are recorded from the Galapagos, being fully one-tenth of the number of flowering plants; yet only seven of them are peculiar to the islands.

The Gymnospermeæ (Coniferæ, Cycadaceæ, and Gnetaceæ) seem absolutely unrepresented in the remoter Oceanic islands, as well as in many relatively near continents. Exceptions are: Bermudas, one species of *Juniperus;* Azores, one endemic species of *Juniperus;* Madeira and the Canaries, three species of *Ephedra*, two or three species of *Juniperus*, and one endemic *Pinus;* and in the southern hemisphere, Norfolk Island and New Caledonia possess Gymnosperms; while in New Zealand there are five genera and about a dozen species, forming a large proportion of the forests. The outlying insular groups, Chatham, Auckland, Campbell, &c., on the other hand, are destitute of Gymnosperms. In the Mauritius there is none, while in Madagascar there is one endemic species each of *Cycas* and *Podocarpus*.

Another group of plants very poorly represented in, or entirely absent from many oceanic islands, is the *Petaliferous Monocotyledons*. They are quite absent from Ascension, St Helena, South Trinidad, the Tristan da Cunha group, and all the islands

eastward to Amsterdam and the Macdonald group. The Bermudas possess three; Falklands, seven; Juan Fernandez, two; the Galapagos, three; and the proportion is small in most insular groups. Orchids are singularly scarce in insular floras; yet they are so widely dispersed, nearly reaching the polar limits of flowering plants, and occupy such a variety of soils and situations, that their rarity in oceanic islands would seem to be due rather to secondary than primary causes.[1] In illustration of this phenomenon, we append a table showing the absence, or number of species inhabiting various islands.

ORCHIDEÆ IN INSULAR FLORAS.

	Number of Species.
I. ARCTIC OCEAN:	
Nova Zembla	0
Spitzbergen	0
II. NORTH ATLANTIC OCEAN:	
Iceland[2]	13
Azores	3
Bermudas	1
Madeira	4
Canaries	6
Cape Verde group	1
III. SOUTH ATLANTIC OCEAN:	
Fernando Noronha	0
Ascension	0
St Helena	0
South Trinidad	0
Tristan da Cunha group	0
South Georgia	0
South Orkney	0
Falklands	4
IV. INDIAN OCEAN:	
Socotra	1
Seychelles	10
Rodriguez	5
Keeling	0
Marion	0
Crozets	0
Kerguelen	0
Heard	0
Amsterdam	0
St Paul	0
V. NORTH PACIFIC OCEAN:	
Sandwich	3
Guadalupe	0
VI. SOUTH PACIFIC OCEAN:	
Galapagos	2
Tahiti	19
Juan Fernandez	0
Masafuera	0
Norfolk Island	5
Kermadec	1
Chatham	10
Aucklands	9
Campbell	2
Macquarie	0

The foregoing selection of islands and islets covers a wide area of the globe, and

[1] How far the absence, or rarity, of Leguminosæ, Gymnospermeæ, and Petaliferous Monocotyledons in oceanic islands, and of the first in the Antarctic regions, may be accidental or due to climatal conditions, is conjectural; the concomitant rarity of insects, however, is a very probable reason so far as the first and last are concerned; but we know too little of the interdependence of plants and insects generally. From the observations of Darwin, Delpino, H. and F. Mueller, and others, it appears certain that fertilisation without insect agency is impossible in many plants, and especially so in a large number of the Leguminosæ and Orchideæ. Gymnospermeæ, on the other hand, are anemophilous. Further, if the seeds of any flowering plants be transportable very long distances by winds, it is those of orchids, for they are most exceedingly minute and light; and they are produced in astonishing numbers. Darwin (Ann. and Mag. Nat. Hist., ser. 4, vol. iv. p. 158) mentions that it had been calculated that a single plant of *Acropera* probably sometimes produced as many as seventy-four millions of seeds in one year; and Fritz Mueller estimated the number of seeds in one capsule of a *Maxillaria* at 1,756,440!

[2] Groenlund (Botanisk Tidsskrift, 2, iv. p. 57) places the sign of doubt before seven of the species recorded by various authors, and suggests that some of them at least have been wrongly named, or erroneously attributed to Iceland. He is most likely right in some instances; but with regard to *Listera ovata*, which he questions, the specimen authenticated by Paulsen exists in the Kew Herbarium. Martins records seven species from the Færœs.

includes the greatest possible variety of physical conditions. Beginning with Spitzbergen and Nova Zembla, it may seem probable at first that their Arctic climate is too severe for members of the orchid family; yet, when we remember that *Platanthera hyberborea*, *Habenaria albida*, and *Listera cordata* are abundant and luxuriant on Disco Island, Davis Strait, in about 69° 15′ N. lat., climate does not adequately explain the absence of orchids from the two first countries, because the warm oceanic current would more than counterbalance the slight difference in latitude. Then, no fewer than thirteen species of orchids are recorded from Iceland, where also a rigorous climate prevails. Some of the species are extremely rare, however, and it is possible that the order is decreasing in numbers and gradually disappearing from this flora. All the species inhabit Continental Europe, and some of them have also a wide range in the Arctic zone. The Azorean orchids are *Serapias cordigera*, a South European species, and two endemic species of *Habenaria*.

The solitary Bermudan orchid is *Spiranthes tortilis*, a native of Jamaica and Antigua, and a member of the most widely spread genus of the Orchideæ, if we except the somewhat heterogeneous *Habenaria*. *Spiranthes australis* is perhaps the commonest and most widely diffused species of orchid, ranging, as it does, from Afghanistan to Sachalin and Japan, southward to Australia, New Caledonia, and New Zealand.

Altogether there are eight species of orchids in Madeira and the Canaries, whereof three are endemic and the rest Mediterranean.

The four orchids occurring in the Falklands are *Chloræa gaudichaudii*, *Asarca commersonii*, *Asarca odoratissima*, and *Codonorchis lessonii;* the first being apparently endemic, and the others South American.

Socotra has now been pretty thoroughly explored, yet only one orchid, a species of *Habenaria*, has been discovered; but the adjacent countries are also poor in orchids. None has been found at Aden, and the delta and valley of the Nile yield none. One only of the five Rodriguez species is endemic; and only two of the Seychelles species are endemic. Seventy-four species are recorded from the Mauritius.

Turning to the Pacific, the three orchids inhabiting the Sandwich Islands are endemic; they are all three terrestrial, and two of them belong to genera peculiar to the Malayan Archipelago and Polynesia, while the third is a species of the widely spread *Liparis*, and described as intermediate between *Liparis læselii* and *Liparis liliifolia*.

Epidendrum spicatum, and an undetermined orchid, perhaps a species of *Govenia*, collected by Captain Wood, and preserved in the Kew Herbarium, are the only Galapageian orchids at present known. The former is endemic, and the latter insufficient for determination: both genera are otherwise exclusively American. We have seen no orchids from any of the smaller islands of Eastern Polynesia, but there seems to be a fair proportion in the larger—Tahiti, according to Nadeaud, possessing nineteen.

That Juan Fernandez should possess none is surprising, considering the general Chilian affinities of its vegetation.

The number set down for Norfolk Island is probably too low, having been taken from Endlicher's Prodromus (1833). Finally, we come to the New Zealand region, that is to say, New Zealand and the adjacent islands included in Hooker's Handbook of the New Zealand Flora. Eighteen genera and upwards of forty species have been discovered, and two of the genera are endemic, while the rest are also Tasmanian or Australian; none extend to Southern America, the few genera there being distinct and mostly peculiar. With one exception, *Chiloglottis cornuta* in the Auckland Islands, which may yet be found in New Zealand, the orchids found in the Kermadec, Chatham, Auckland, and Campbell Islands, are New Zealand species; a fact pointing to a former land connection. The general distribution of orchids warrants this assumption, for there are comparatively few genera of very wide range, and these, with few exceptions, are the terrestrial genera which have their greatest concentration in the temperate zone of the northern hemisphere. Thus, of the ten orchideous genera represented in California, eight are British, and a ninth, *Calypso borealis*, is also found in Northern Europe and Siberia; while only one is peculiar to America.

THE GENERAL AND INSULAR DISTRIBUTION OF THE GENERA *CAREX* AND *UNCINIA*.

Among large genera especially interesting on account of their insular distribution is *Carex*, comprising about six hundred species, which are, perhaps, more widely dispersed than those of any other genus of flowering plants; and they grow in a very great variety of situations, from the extreme polar limits of vegetation down to the most remote islands, though within the tropics they are almost restricted to the mountains. *Carex*, too, is the only one of the very large and widely dispersed genera that is represented in most of the oceanic islands. *Euphorbia* is represented in Ascension and in many of the Pacific Islands, and *Cyperus* in nearly all of the tropical islands; but *Carex* occurs in a large number of islands, both in the temperate and tropical zones, and in all three of the great oceans. It may be interesting, therefore, to give some more definite particulars of the general distribution of the species. A considerable number of the species are widely spread, some very widely spread; yet in almost all parts where these commoner species penetrate, they are associated with local species. Those growing in the more remote oceanic islands are mostly endemic in single islands or groups of islands. Thus, in the Bermudas, there is one species, which is endemic; in St Helena there are two, both endemic; in the Tristan da Cunha group there are two, both endemic; in Juan Fernandez the only species is endemic; in the Sandwich Islands, three out of six are endemic; and of the twelve species found in the Azores six are endemic, and that, be it remembered, in a flora containing a very small endemic element. On the other hand, the six which inhabit

the Canaries are all widely dispersed species, and the only one recorded from Rodriguez is common in Tropical Asia and Australia.

Approximate Number of Species of Carex in various Islands and Continental Areas.

Arctic Regions	37	Abyssinia	5	Campbell Island	2
Greenland	40	Kilimanjaro	3	Chatham Islands	11
Europe	163	Cameroons	5	Norfolk Island	1
Spitzbergen	10	South Africa	12	Isle of Pines, New Caledonia	1
Iceland	32	Levant (Boissier)	93	Aneiteum	1
Sweden	99	Palestine	14	Fijis	3
Norway	102	Arabia	2	Samoa	1
Government of Vologda	34	Persia	12	Philippine Islands	7
Britain	60	Tauro-Caucasus	34	Marianne Islands	2
France	93	India	100	Sandwich Islands	6
Germany and Switzerland	109	Ceylon	16	North America	315
Italy	96	Amur	24	California	78
Maritime Alps	45	Peking	10	British North America	150
Pyrenees	75	Hong-Kong	9	Northern United States	151
Spain	66	Japan	95	Southern United States	80
Portugal	20	Malayan Archipelago	23	West Indies, British	2
Bermudas	1	Rodriguez	1	Cuba	2
Azores	12	Mauritius	5	Mexico and Central America	20
Canaries	6	Madagascar	6	New Granada to Peru and Bolivia	12
St Helena	2	Australia	29	Brazil	5
Tristan da Cunha	2	Queensland	10	Argentine	16
Algeria	30	Australia, West	5	Chili	30
Marocco (Ball)	10	Tasmania	13	Juan Fernandez	1
Egypt	2	New Zealand	40	Falklands	6
Oases	1	Auckland Islands	4		

The general dispersion of the genus *Carex*, together with the fact that the insular species are mostly endemic, seem to indicate that it is a very old type. With the exception of the south-eastern groups of Polynesia (the Society and the Marquesas, for example), the Galapagos, and the small islands in the southern part of the Indian Ocean, *Carices* cover, more or less plentifully, nearly all frigid, temperate, and subtropical areas. The paucity of species in the mountains of the West Indies and in the Andes is remarkable ; but what is more singular, several of the common species of the northern hemisphere are found in New Zealand, and nowhere else, so far as we know, in the southern hemisphere. It is noteworthy, too, that some of the insular species are among the larger ones of the genus. *Carex prœalta* of St Helena grows six feet high, and is stout in proportion ; and *Carex trifida* of New Zealand and the Falklands is a very robust species. The almost equally large genus *Cyperus* is generally diffused in hot countries, and a few species extend into

temperate regions, and there is no doubt that these two genera combined almost cover the whole range of phanerogamic vegetation.

Uncinia, a genus of between twenty and thirty species, differs from *Carex* in the rhachilla protruding from the utricle and being uncinate or glochidiate; and *Carex microglochin*, which is widely dispersed in the northern hemisphere, and recurs in the extreme south of America, is a connecting link between the two; indeed, some botanists refer it to *Uncinia*. The genus *Uncinia* ranges from Australia and New Zealand through the islands in the southern part of the Indian Ocean to Fuegia, and northward along the Andes to Mexico and the West Indies. The parts actually inhabited are Lord Howe's Island, one endemic species; the mountains of Victoria and Tasmania, three species common to both localities; New Zealand, ten species, one of which extends to the Auckland and Campbell Islands, and another to Kerguelen, Amsterdam, and St Paul Islands, while a third is very near, if not the same, as the one species found in the Sandwich Islands. Besides the one New Zealand species found in Amsterdam Island there is another, which also inhabits the Tristan da Cunha group. There are also about ten species in the American region, chiefly concentrated in the extreme south. One species is recorded from the Falklands, but this we have not seen, and there is one endemic species in Juan Fernandez; one ranges from Ecuador to New Grenada, Venezuela, and Jamaica, and another, closely allied to the last, is restricted to Central America and Mexico. This completes the whole area of the genus, for the Abyssinian plant referred to *Uncinia* by Hochstetter is a true *Carex*.

WOODY PLANTS IN OCEANIC ISLANDS.

The preponderance of woody plants in most remote insular floras is undeniable; but that islands "often possess trees or bushes belonging to Orders which elsewhere include only herbaceous species," as stated by Darwin (Origin of Species, p. 392), is incorrect, as may be seen from the following parallels in insular and continental floras. The distribution of arboreous Compositæ is discussed separately.

Sinapidendron (Cruciferæ), from Madeira and Canaries, is represented in Spain and Algeria by much more truly shrubby plants belonging to the genera *Euzomodendron*, *Vella*, and *Oudneya*.

Frankenia portulacæfolia, St Helena, finds a parallel in the Australian *Frankenia pauciflora*, which is shrubby, and sometimes attains a height of three feet.

Alsinidendron and *Schiedea* (Caryophylleæ), Sandwich Islands, cannot be said to have exact counterparts, either continental or insular; but the anomalous *Sphærocoma* of Eastern Africa and Western Asia is also truly shrubby.

Gunnera (Haloragеæ), Juan Fernandez: caulescent species appear to be unknown elsewhere.

Pharnaceum acidum (Ficoideæ), St Helena, is less woody than several of the South African species of the genus.

Bupleurum (Umbelliferæ), Juan Fernandez, has an analogue in the South European *Bupleurum fruticosum;* and the tropical African genera *Steganotænia* and *Heteromorpha* include truly arboreous species, which the Juan Fernandez *Bupleura* are not.

Lobeliaceæ, Sandwich and Society Islands: the endemic genera of this order are represented by equally tall and woody members, belonging to the genera *Centropogon* and *Siphocampylus*, &c., in America.

Echium in the Canaries, *Heliotropium* in St Helena, and *Selkirkia* in Juan Fernandez, belonging to the Borragineæ, are represented in South Africa by many truly shrubby species of *Lobostemon.*

Cuminia (Labiatæ), Juan Fernandez: the species of this genus are surpassed in size by the South American *Hyptis membranacea*, which grows thirty to forty feet high, and equalled by *Hyptis arborea* from the same country; and there are many large shrubby and subarboreous Labiatæ in Australia and India.

Plantago: the St Helena, Juan Fernandez, and Sandwich Islands species of this genus are unapproached in their character of miniature trees, with an unbranched stem, by any continental species that we have seen; yet some of the South American species are woody. Wawra (Flora, 1874, p. 563) states that the stem of the Sandwich Island *Plantago princeps* is sometimes as much as six feet high.

So far, then, as these insular woody plants are concerned, and the same holds good for the arboreous Compositæ, which constitute so prominent a feature in the vegetation of several oceanic islands, they cannot be regarded as peculiarly insular, though they largely characterise insular floras. Instances of shrubby and arboreous species of orders, or of large genera otherwise herbaceous or shrubby, are not wanting in larger islands and continents. The shrubby Veronicas of New Zealand culminate in *Veronica elliptica*, Forst., which is arboreous in favourable situations, attaining a height of twenty feet; and, what is more remarkable, this species inhabits New Zealand, the Chatham, Auckland, and Campbell Islands, and South Chili, Fuegia, and the Falkland Islands. This, however, is not adduced as a special instance. In Chili there is the shrubby *Oxalis gigantea*, which grows three to six feet high, and there are several shrubby species of *Viola;* but the localities where they grow are probably as insular in their physical conditions, except isolation, as the islands themselves.

INDIGENOUS AND ENDEMIC GENERA AND SPECIES OF FLOWERING PLANTS IN VARIOUS ISLANDS AND CONTINENTAL AREAS.

The vegetation of some of the remote oceanic islands is remarkable for the large number of endemic genera and species it contains, but not more so than that of some

continental areas, especially in the southern hemisphere. The following statistics illustrate this point:—

	Genera.		Species.	
	Indigenous.	Endemic.	Indigenous.	Endemic.
Aden	79	1	94	14
Amsterdam Island	12	0	16	4
Arctic Regions	220	1	770	8
Ascension[1]	8	0	8	2
Auckland Island[2]	57	0	85	8
Australia[3]	1393	425	8800	7550
Australia, West	...	100	3136	2680
Azores[4]	249	0	478	40
Bermudas[5]	97	0	120	4
Campbell Island	42	0	61	3
Canaries	...	15	977	269
Chatham Island	56	1	62	9
Crozets	5	0	5	0
Cuba	...	...	2984	929
Falklands	84	0	115	26
Fernando-Noronha	48	0	58	5
Heard Island[6]	4	0	4	0
Galapagos[7]	164	7	332	174
Iceland[8]	175	0	433	0
Japan	1035	48	2743	...
Juan Fernandez	46	10	102	70
Kerguelen	18	1	21	3
Macquarie	13	0	16	0
Madeira	...	...	648	103
Marion	7	0	8	0
Mauritius	...	...	705	195
New Zealand[9]	303	28	935	677
Philippine Islands	1002	7	3466	915
Rodriguez	119	3	176	36
St Paul	8	0	10	3
St Helena[10]	44	5	62	38
Sandwich	253	39	512	376
Seychelles	180	7	258	52
Socotra	324	16	600	200
Spitzbergen	54	0	116	0
Tasmania	394	22	1063	267
Trinidad, South	9	0	9	3
Tristan da Cunha	23	0	29	15
West Indies[11]	...	...	4401	2155

[1] This number is probably too high, for possibly only two species are indigenous: see remarks, Part II., pp. 31–34.

[2] *Pleurophyllum*, a genus of Compositæ, is restricted to the Campbell, Auckland, and Macquarie Islands.

[3] These numbers are taken from Baron Mueller's Lecture on the Flora of Australia, 1882, and include the vascular cryptogams. He there (p. 11) states that there are 550 genera in Australia, represented by only one species each, and 160 of these genera are monotypic and endemic in Australia.

[4] The endemic species comprise several seggregate or critical ones; and the number of genera is considerably in excess of what it would be on the basis of Hooker and Bentham's Genera Plantarum.

[5] The endemic species are very closely allied to continental ones.

The figures in this table are, of course, in many instances, merely rough approximations, and they are not all based on one generic standard; still, they are sufficiently near the truth to give some idea of the proportions. Several of them are taken from Engler's Versuch einer Entwicklungsgeschichte der Pflanzenwelt, and the others which are not our own are taken from the various works enumerated in the Bibliography, p. 71. Unfortunately, there are few published statistics relating to large continental areas. It is clear, however, that the endemic element is equally as high in certain continental areas as it is in any of the oceanic islands. Even if we reduce the indigenous element of the flora of St Helena to the endemic species, and that would be going too far, there would be only five endemic genera out of twenty-seven. In Juan Fernandez the proportions, after deducting several genera, which are probably indigenous, are ten out of forty-six; in the Sandwich Islands thirty-nine out of 253, and in the Galapagos seven out of 164. In the larger islands of New Zealand these proportions are unequalled, while in Australia the endemic genera amount to considerably more than a quarter of the whole, the exact proportion being 30·5 per cent. In Madagascar, Mr J. G. Baker informs us, out of about 730 genera of flowering plants known to be represented in the island, about 100, or 13·7 per cent., are endemic. In Extratropical South Africa, the proportion of endemic genera is certainly not quite so high as in Australia, for many of the genera which add largely to the total of endemic species, such as *Pelargonium*, *Oxalis*, *Phylica*, *Mesembryanthemum*, *Erica*, and *Gladiolus*, have a wider distribution. On the other hand, the proportion is much higher than in Madagascar, so far as the flora of the latter has been investigated. Engler (*loc. cit.*, p. 190) gives the number of endemic dicotyledonous genera in Brazil as 215, with 124 more restricted to North Brazil, Guiana, and Venezuela. This is a large proportion; but the figures are not available for comparison, because we do not know the total number of genera represented in Brazil. Taking the whole of Tropical America, there are, according to the same authority (p. 173), 1448 genera of dicotyledons; and the

[6] Taken in conjunction with Marion, the Crozets, and Kerguelen, this little flora comprises twenty-one species of flowering plants belonging to eighteen genera, two of which are endemic; and six of the species are endemic.

[7] Five of the reputed endemic genera since reduced in Bentham and Hooker's Genera Plantarum.

[8] The latest enumeration of Iceland plants is by Groenlund (Botanisk Tidsskrift, 2, iv. p. 36), who admits 317 flowering plants, and places a note of interrogation before all the names of plants of which he had no authentic specimens.

[9] A few additional genera and species have been described since the publication of Hooker's Handbook, from which these figures were taken. Engler's numbers for New Zealand, including vascular cryptogams, are:—Genera, 343, of which 20 are endemic [but a species of *Carmichaelia* has since been found in Lord Howe's Island; therefore, 19], and 1094 species, of which 671 are endemic.

[10] The total numbers of genera and species are probably too high: see remarks, Part II., p. 55.

[11] The number of dicotyledonous genera, according to Grisebach's computation, was 1030, comprising 1789 endemic species belonging to 540 genera, and 1866 not endemic species belonging to 763 genera. Of the total number of endemic species given in the table, 849 are peculiar to Cuba, 275 to Jamaica, Trinidad 83, Dominica 29, and St Vincent 12, the other smaller islands being almost destitute of endemic species.

total endemic genera for the different areas of Tropical America is 622 (p. 190). Adding to this number the genera extending to two or more of the areas, but not beyond Tropical America, the proportion of endemic genera must be even higher than in Australia.

With regard to the proportion of endemic species in oceanic islands compared with continental areas, it will be seen that it is higher in Australia, and doubtless as high in South Africa and in some parts of South America, as well as in Mexico.

PROPORTION OF MONOTYPIC ENDEMIC GENERA TO THE TOTAL ENDEMIC GENERA IN VARIOUS ISLANDS AND CONTINENTAL AREAS.

The following are the monotypic endemic genera in the remote oceanic islands dealt with in this work: *Nesiota*, *Petrobium*, and *Mellissia* in St Helena; *Pringlea* in the chain, if we may so term it, of islands, from the Prince Edward group to the Macdonald group; *Lyallia* in Kerguelen only; and *Rhetinodendron*, *Selkirkia*, *Lactoris*, *Ochagavia*, *Juania*, *Pantathera*, and *Podophorus* in Juan Fernandez: the total endemic genera being respectively five, two, and ten. For comparison, we extract from Engler (*loc. cit.*, p. 133) some particulars of the proportions in various other parts of the world, intercalating our own; limited, however, to the dicotyledons:—

Country.	Total Endemic Genera.	Monotypic Endemic Genera.	Percentage of Monotypic Endemic Genera.
Marion to Heard Island	2	2	100 per cent.
Japan	48	43	89 ,,
Ceylon	21	18	86 ,,
New Zealand	22	17	77 ,,
Fiji Islands	13	10	77 ,,
Chili	64	44	69 ,,
Madagascar	91	59	65 ,,
East Australia	151	92	61 ,,
St Helena	5	3	60 ,,
New Caledonia	38	18	47 ,,
Mascarene Islands	34	16	47 ,,
West Australia	99	45	45 ,,
Sandwich Islands	32	10	31 ,,
Juan Fernandez[1]	10	3	30 ,,

The percentages of monotypic genera for East Australia and New Caledonia are given by Engler as 65 and 47 respectively, evidently through some clerical error. The five Japanese endemic genera which are not monotypic are all ditypic; while eleven of the New Caledonian and sixteen of the Madagascar endemic genera are also ditypic.

[1] Adding the monocotyledons the percentage rises to 70.

ORDERS, GENERA, AND SPECIES OF VERY RESTRICTED AREAS.

For purposes of comparison, a few particulars concerning some continental types of different grades of very restricted areas may be introduced here, if only to show that, from some cause or causes, such exist. We have not space to discuss the possible causes, but it is probable that these types are either dying out or are of comparatively recent origin. From the particulars given below, it appears that inability to produce abundance of good seed is not the cause, in some cases at least.

ORDERS RESTRICTED TO ONE CONTINENTAL AREA.

The number of Natural Orders restricted to one region or one continent is considerable even as the orders are circumscribed in Bentham and Hooker's Genera Plantarum; and taken in the more limited sense adopted by De Candolle (Géographie Botanique, p. 1158), the number would be about double. Thus, taking the former work as a basis, the Tremandreæ are peculiar to Australia; the Vochysiaceæ to Tropical America; the Chlænaceæ to Madagascar; the Cactaceæ (except *Rhipsalis*) to America; the Calycereæ to Extratropical South America; the Bruniaceæ to South Africa; the Nepenthaceæ to the tropics of the Old World, excluding continental Africa; the Bromeliaceæ to America, the Mayaceæ to America, the Cyclanthaceæ to Tropical America; but the number peculiar to smaller areas is barely half-a-dozen, and, as might be expected, they comprise very few genera and species. Moreover, some of them have perhaps less claim to rank as independent orders than some groups that are reduced to suborders or tribes, and no more claim to the same rank than some of the anomalous genera; but as connecting links are wanting they are given the superior rank. There is one such order, the Balanopseæ, restricted to New Caledonia, and consisting, as far as at present known, of one genus and six or seven species. Another order, the Leitnerieæ, comprising only one genus and two species, is peculiar to Florida and Texas. The Columelliaceæ, one genus and two species, are restricted to the Andes of Ecuador and Peru; while the singular Lennoaceæ, consisting of three genera and four or five species, inhabit only Mexico and California. Another small order, the Rapateaceæ, consisting of five genera and about twenty species, is limited to Guiana and Tropical Brazil. As an instance of a small order occupying distant, separated areas, the Sarraceniaceæ may be named. This order comprises three genera: *Sarracenia*, of which there are several species inhabiting Eastern North America; *Darlingtonia*, a monotypic genus inhabiting the mountains of California; and *Heliamphora*, also monotypic, which is only known from the mountains of British Guiana.

DISTINCT CONTINENTAL GENERA OF VERY RESTRICTED AREAS.

There are probably scores, or even hundreds, of monotypic continental genera confined to very small areas; perhaps not very many to such small areas as St Helena or Juan Fernandez, or the islands of the Sandwich, Galapagos, or Seychelles groups; but, nevertheless, many very distinct genera have hitherto only been met with in one locality or district, especially continental genera of the southern hemisphere. Of course we cannot assume that they do not exist in more than one district because they have hitherto not been found elsewhere. De Candolle (Géographie Botanique, p. 1141), in giving examples of genera of very wide and very limited areas, cites insular genera only of the latter category. In the absence of more exact information we can give examples of a few genera which appear to be comparatively local. Whether, like the eastern Asiatic *Ginkgo* (*Salisburia*), and the North American *Sequoia*, they are survivors of types having a much wider distribution during the tertiary period, is a question that we can only suggest. *Darlingtonia* and *Heliamphora* (Sarraceniaceæ, cited on p. 36 as an example of an order of discontinuous area) are instances of highly differentiated monotypic genera of a very curious order, apparently of comparatively local existence, though the former ranges from the Truckee Pass to the borders of Oregon. It is singular, too, that some other of the so-called carnivorous genera of plants are very local. Thus, *Dionæa* is confined to North Carolina and the adjacent parts of South Carolina. The Hamamelideæ, also a very remarkable order, comprise a number of monotypic genera, several of which are at present only known from single localities or narrowly limited districts; and none of them, except Liquidambar, has anything approaching a wide range. This genus now occupies several widely separated areas in North America, Asia Minor, and the extreme Eastern Asia; but during the tertiary epoch it inhabited the intervening country. The Begoniaceæ consist of the very large genus *Begonia*, which is widely spread in warm countries of both hemispheres, and one very small very distinct genus, *Begoniella*, which inhabits the Andes, and the monotypic *Hillebrandia*, a native of the Sandwich Islands. *Columellia*, mentioned at p. 36, has a restricted range in the Andes; *Gosela* (Selagineæ) is a monotypic South African genus of apparently very restricted area; *Atkinsonia* (Loranthaceæ) is only known from the Blue Mountains in New South Wales; and *Saprium* (Cytinaceæ) has only been gathered in one place in Eastern Bengal. The number of monotypic genera of Orchideæ, known from only one locality, is considerable, but it is hardly worth while giving a list of names. *Lapiedra* and *Tapeinanthus* (Amaryllideæ) are instances of European local genera, the former being found only in Southern Spain, and the latter in Southern Spain and Tangiers. Finally, the distribution of the Burmanniaceæ is interesting in this connection. *Burmannia* itself is spread nearly all over the tropics, and *Gymnosiphon* is represented in America, Africa, and the Malayan Archipelago; while several others which exhibit some marvellous deviations

in the forms of their flowers, such as *Bagnisia* (New Guinea), *Geomitra* (Borneo and Java), *Corsia* (New Guinea), and *Arachnites* (Chili), are apparently local or very local. In conclusion, one or two examples of genera represented by the same species in widely separated areas may be given: *Diphylleia*, a genus of Berberidaceæ, regarded by Dr A. Gray and other botanists as monotypic, inhabits Japan and Virginia and North Carolina. The eastern Asiatic plant has, however, been described as an independent species. *Coleanthus*, a genus of grasses, is another monotype inhabiting widely separated areas, having been found in France, Bohemia, and Norway, and also recently in Sauvies Island, in the mouth of the Oregon river, North-west America. In this instance there is no question of the identity of the species.

DISTINCT CONTINENTAL SPECIES OF VERY RESTRICTED AREAS.

From what has been said in the paragraphs on orders and genera of very restricted areas, it follows that the number of continental species found in single localities or districts is large, amounting perhaps to thousands. Therefore it will be sufficient to name a few well-authenticated instances of such plants in order to demonstrate that very local species are not peculiar to oceanic islands, and that some plants are unable from some cause or causes to extend their areas, though able to hold their ground in certain localities.

Hudsonia montana, Nutt.; Chapman, Fl. Southern U.S., p. 36.—A very small-flowered, very small shrubby member of the Cistineæ, found only on Table Rock, North Carolina. The genus comprises three species restricted to the eastern maritime states of North America.

Neviusa alabamensis, A. Gr. in Mem. Amer. Acad. Sci., N.S. vi. p. 374; Bot. Mag., t. 6806.—A member of the Rosaceæ, hitherto only found near Tuscaloosa, in Alabama. It is the only species of the genus, and might, therefore, also figure as an example of a continental genus of very restricted area.

Saxifraga florulenta, Moretti, Tent. Saxif., p. 9; Bot. Mag., t. 6102; Regel, Gartenflora, 1874, pp. 2 et 314, t. 782.—This very distinct and striking species is very local, yet not uncommon within its limited area. Sir J. D. Hooker (Bot. Mag., *loc. cit.*) states that it was first discovered in the Alps of Fenestre, about the year 1820, by an English tourist; and he says it appears to be tolerably abundant at an altitude of from 7000 to 9000 feet within an area of about eight square miles, in the Maritime Alps, between the Col di Tenda and the valley of the Tinea, north of Nice, but is not found elsewhere.

Dionæa muscipula, Ellis; Chapman, Fl. Southern U.S., p. 37; Bot. Mag., t. 785.—This and the next are given as examples of genera of restricted area. North and South Carolina.

Rhodoleia championi, Hook., Bot. Mag., t. 4509.—In the paragraph on genera of very restricted areas, special mention is made of the local character of several of the

monotypic genera of the Hamamelideæ, of which this is a member, and the most showy one of the order, being as conspicuous as a Camellia ; yet it has hitherto, we believe, been found in a wild state only in the island of Hong-Kong. This island being within half a mile of the mainland is practically continental.

Campanula isophylla, Moretti ; App. Schouw., Fl. Ital., p. 22 ; Bot. Mag., t. 5745 ; Moggridge, Contrib. Fl. Ment., t. 80.—Like *Saxifraga florulenta*, this is a striking plant, and even showy when in flower. According to Moggridge, the latest authority, this is only known to grow along the small strip of coast, about two and a half miles in length, from the promontory of Caprazoppa to near the little town of Noli. The same author says it is difficult to account for the restricted area, because it produces large quantities of seed, which germinates freely, and is so minute as to be easily transported by winds, or by adhering to the feet of small birds when wetted by hopping in dewy grass, &c.

Lithospermum gastoni, Benth. in DC. Prodr., x. p. 83 ; Bot. Mag., t. 5926 ; Regel, Gartenflora, 1874, t. 812.—A conspicuous species first discovered at the Pic de Gers in 1839, and since collected at the Pic d'Anie and Col de Tartes, all in the Basses Pyrenees.

Leucojum hiemale, DC., Fl. Franc. Suppl., p. 326, var. *α* ; Bot. Mag., t. 6711 ; Moggridge, Contr. Fl. Ment., t. 21.—This pretty and distinct species of snowflake is only known in a wild state on a small strip of rocky shore reaching from Nice to about two miles east of Mentone.

Galanthus olgæ, Orphanides ; Boiss., Fl. Or., v. p. 144.—Only recorded from Mount Taygetus in Greece ; and there are one or two other species equally local.

Dioscorea pyrenaica, Bubani et Bordère in Bull. Soc. Bot. France, xiii. p. 382, t. 1.—This remarkable plant inhabits the Central and Eastern Pyrenees of Spain, and is equally or even more interesting on account of its isolation from the rest of the genus than as a species of very restricted area. The genus *Dioscorea* numbers about 150 species, generally spread over tropical countries, and a few inhabiting temperate regions in Eastern Asia, North and South America, and South Africa ; but the present species is the only one in Europe, and there is none in Northern Africa nor in Western Asia, nor indeed within the limits of Boissier's Flora Orientalis. In habit it is nearest to Mexican and Chilian species.

DO INSULAR TYPES OF THE VEGETABLE KINGDOM EXHIBIT ANY VERY SPECIAL STRUCTURAL OR OTHER PECULIARITIES IN THEIR FLOWERS?

We have shown that the physiognomical characteristics of insular vegetation are repeated in continental countries, and also, that there are continental genera and species equally as local in their habitats as the insular ones ; but, generally speaking, the physical conditions, excepting the insularity, are very similar in the two cases.

With regard to the size, shape, colour, and structure of the flowers of the endemic

plants of oceanic islands, the question arises, Do they present any peculiarities? Let us examine the endemic element of the St Helena flowering plants. Firstly, with regard to size: taking order by order and genus by genus, the flowers or flower-heads, as the case may be, will be found rather above than below the average of the order or genus. Excluding the Cyperaceæ and Gramineæ, there are thirty endemic flowering plants, and for purposes of comparison it may be worth giving the size, and colour, and structure of their flowers or flower-heads in a tabular form, premising that they offer no abnormalities in shape. The coloured figures in Melliss's St Helena have been utilised for size and colour.

SIZE AND COLOUR OF THE FLOWERS OF THE ENDEMIC PLANTS OF ST HELENA, WITH REMARKS ON STRUCTURE, &c.

Name.	Size of Flowers or Flower-heads.	Colour.	Peculiarity in Structure.
Frankenia portulacæfolia	$\frac{1}{4}$ in. across	White	Dimerous ovary.
Melhania melanoxylon	3 ins. across	White changing to red	Habit of *Trochetia*, with structure of *Melhania*.
„ *erythroxylon*	$2\frac{1}{2}$ ins. long	White changing to red	Habit of *Trochetia*, with structure of *Melhania*.
Pelargonium cotyledonis	1 in. across	White	Normal.
Phylica ramosissima	Minute	Greenish yellow	Normal.
Nesiota elliptica	Small	Reddish	Differs from *Phylica* in opposite leaves and larger corymbose flowers.
Mesembryanthemum cryptanthum	$\frac{1}{4}$ in. across	White	Petals shorter than calyx.
Pharnaceum acidum	1 in. across.	White	Unequal sepals and entire stipules.
Sium burchellii	Small	White	Normal.
„ *helenianum*	Small	White	Normal.
Hedyotis arborea	Small	White	Short rotate corolla.
Commidendron burchellii	$\frac{1}{2}$ in. across	White and yellow	Achenes compressed with three or four ribs on each side.
„ *spurium*	$\frac{1}{4}$ in. across	White and yellow	Achenes compressed with three or four ribs on each side.
„ *robustum*	$\frac{3}{4}$ in. across	Yellow	Achenes compressed with three or four ribs on each side.
„ *rugosum*	$1\frac{1}{4}$ in. across	White and yellow	Achenes compressed with three or four ribs on each side.
Melanodendron integrifolium	1 in. across	White and yellow	Achenes 3–5-ribbed.
Petrobium arboreum	$\frac{1}{2}$ in. across	White	Biaristate pappus.
Psiadia rotundifolia	Small	White	Normal.
Senecio leucadendron	$\frac{1}{4}$ in. across	White and yellow	Erect inflorescence of small flower-heads.
„ *prenanthiflora*	Very small	White	Pendulous inflorescence of very narrow heads.
Tripteris burchellii	$\frac{3}{4}$ in. across	Yellow	Normal.
Lobelia scævolæfolia	$\frac{5}{4}$ in. across	White	Normal.
Wahlenbergia angustifolia	1 in. across	White very faintly tinged with blue	Normal.
„ *linifolia*	$1\frac{1}{4}$ in. long	White	Normal.
„ *roxburghii*	$\frac{3}{4}$ in. long	White	Normal.
„ *burchellii*	$\frac{3}{4}$ in. long	White	Normal.
Plantago robusta	Minute	Green	Normal.
Heliotropium pannifolium	Small	Whitish	Normal.
Mellissia begonifolia	$\frac{3}{4}$ in. across	White	Differs from *Saracha* in solitary flowers.
Acalypha rosea	Minute	Red	Very long slender pendulous flower-spikes.

As already stated, the size of the flowers or flower-heads of the St Helena indigenous plants is on the whole rather above than below the average of those of their allies in other parts of the world. When we come to colour, however, the equality fails altogether, red being almost entirely wanting in the insular plants and blue unknown; for the slight tinge of blue in Melliss's figure of *Wahlenbergia angustifolia* seems to have been added to show the flowers on the white ground. Burchell describes (MSS. in Bibl. Kew) the flowers of all the St Helena species of *Wahlenbergia* as white. The species of *Melhania*, like those of many allied plants, change in colour after expansion. At first they are pure white, becoming pink or brown red according to Melliss, who, however, represents them with a clear, rosy red. Of no other oceanic island are we able to give such full particulars on this point; but it may be asserted that brilliantly coloured flowers are very rare in such situations.[1] Brigham (Proceedings of the Boston Natural History Society, xii. p. 6) says: "There are but few show-flowers, and still fewer fragrant ones, in the Hawaiian Flora. In the colouring white or greenish white is predominant, and yellow and pink follow at a respectful distance. There are very few blue flowers. *Strongylodon lucidum* is a rich crimson, and some other leguminous plants are violet, but the various and brilliant colouring of the Californian plants is wholly absent."

The flora of Juan Fernandez partakes, however, in some measure of the generally more brilliant colouring of the flowers of the south temperate zone. Indeed, Philippi states (Botanische Zeitung, 1856, p. 635) that the Juan Fernandez species of Chilian genera are handsomer, and especially larger-flowered, than their continental congeners.

Returning to the question of the existence of structural peculiarities in insular plants, we may safely say that no general ones exist, and the very distinct genera that occur are not disproportionate. Not a single order, or suborder, or tribe, is endemic in the smaller oceanic islands; and, as more fully set forth elsewhere, the greatest isolation of an order is that of the Balanopseæ in New Caledonia. The endemic genera of St Helena present no anomalies, nor indeed any specially striking differentiations in structure; for it is habit rather than structure that characterises the Compositæ. In the Tristan da Cunha group, and in St Paul and Amsterdam, the endemic element includes no higher rank than species. The other islands in the Southern Indian Ocean which have essentially the same flora (see Part II., p. 251) possess two very distinct, though by no means anomalous genera, namely, *Pringlea* and *Lyallia*. In the Juan Fernandez *Lactoris* we have an example of a truly anomalous genus, the position of which in the natural system is not evident.

The most highly differentiated endemic genera of the Sandwich Islands flora are: *Schiedea* and *Alsinidendron*, shrubby Caryophylleæ exhibiting important structural

[1] In relation to the fertilisation of plants by insects, the absence of native butterflies in St Helena is noteworthy. On this point Melliss (St Helena, p. 180) says: "The varied hues of the St Helena landscape need little to add to their brilliancy [brilliant with exotic plants], or the almost entire absence of butterflies would be more striking. There are but four species in the island, and they have all been imported. With moths it is different: they abound."

peculiarities; *Platydesma*, Rutaceæ; *Hesperomannia*, the only Composite of the sub-order Mutisiaceæ known from the Pacific Islands; *Rollandia*, *Delissea*, *Clermontia*, and *Brighamia*, shrubby and subarboreous Lobeliaceæ; and *Phyllostegia* and *Stenogyne*, herbaceous Labiatæ.

The principal endemic peculiarities of the Seychelles, and other islands in the tropical parts of the Indian Ocean, have been pointed out on p. 11; but there are two or three other remarkable genera deserving of mention, namely, *Roussea*, an anomalous genus of Saxifrageæ, inhabiting Mauritius and Bourbon; the Rodriguez endemic *Mathurina*, an arboreous member of the Turneraceæ, which is described as being most nearly related to *Erblichia*, a monotypic genus native of Panama; and *Dendrosicyos*, an arboreous Cucurbitacea, known only from the island of Socotra.

DISPERSAL OF PLANTS BY OCEANIC CURRENTS AND BIRDS.

In Part III., pp. 277–313, we have brought together all the evidence we have been able to find on the dispersal of plants by oceanic currents and birds, and we have little to add here; but we have drawn up lists of plants which are certainly or probably transported by these agencies. The first, which consists of plants probably dispersed by oceanic currents, is partly derived from the collections of drifted and stranded seeds which we have examined, and partly from other sources; a certain number of widely dispersed littoral plants having been added on the assumption that their present distribution could be accounted for in no other way, and further observation will doubtless greatly augment this list. Among the drift-seeds were many which probably rarely if ever survive long immersion in the sea, and these are not included.

PLANTS CERTAINLY OR PROBABLY DISPERSED BY OCEANIC CURRENTS.

MENISPERMACEÆ.
Cissampelos pareira.

CRUCIFERÆ.
Lepidium piscidium?

BIXINEÆ.
Pangium edule.

PORTULACEÆ.
Portulaca oleracea.

GUTTIFERÆ.
Calophyllum inophyllum.
„ *calaba.*

MALVACEÆ.
Hibiscus tiliaceus.
Hibiscus sp.
Thespesia populnea.

STERCULIACEÆ.
Sterculia.
Heritiera littoralis.

TILIACEÆ.
Triumfetta?

SIMARUBEÆ.
Suriana maritima.

OCHNACEÆ.
Brackenridgea.

MELIACEÆ.
Carapa moluccensis.
„ *guyanensis.*

OLACINEÆ.
Gomphandra.

RHAMNACEÆ.

Alphitonia.
Smythea.
Colubrina asiatica?

AMPELIDEÆ.

Leea.
Vitis.

SAPINDACEÆ.

Sapindus saponaria.
Harpullia.
Dodonæa?

ANACARDIACEÆ.

Anacardium occidentale.
Dracontomelon.
Spondias.

LEGUMINOSÆ.

Pongamia glabra.
Pterocarpus.
Canavalia obtusifolia.
Entada scandens.
Mucuna pruriens.
„ *urens.*
Tephrosia piscatoria.
„ *purpurea.*
Sesbania grandiflora.
„ *aculeata.*
Erythrina.
Dioclea reflexa.
Inocarpus.
Adenanthera pavonina.
Drepanocarpus lunatus.
Ecastaphyllum brownei.
Desmodium umbellatum.
Vigna lutea.
„ *luteola.*
Derris uliginosa.
Cassia sophera.
„ *fistula.*
Acacia farnesiana.
Cæsalpinia nuga.
„ *bonduc.*
„ *bonducella.*

ROSACEÆ.

Chrysobalanus icaco.
Parinarum.

RHIZOPHOREÆ.

Rhizophora mangle.
„ *mucronata.*
Bruguiera rheedii.

COMBRETACEÆ.

Terminalia.
Gyrocarpus jacquini.
Lumnitzera coccinea.

MYRTACEÆ.

Barringtonia speciosa.

MELASTOMACEÆ.

Melastoma denticulatum.

LYTHRARIEÆ.

Sonneratia.
Pemphis acidula.

CUCURBITACEÆ.

Fevillea cordifolia.

FICOIDEÆ.

Sesuvium portulacastrum.

RUBIACEÆ.

Guettarda speciosa.
Mussænda frondosa?
Morinda citrifolia.

COMPOSITÆ?

LOBELIACEÆ.

Scævola kœnigii.
„ *lobelia.*

APOCYNACEÆ.

Ochrosia parviflora.
Ochrosia sp.
Cerbera odollam.
Tabernæmontana.
Plumeria.

BORAGINEÆ.

Cordia subcordata.
Tournefortia argentea.
Heliotropium.

CONVOLVULACEÆ.

Batatas paniculata.
Ipomœa biloba
(*Ipomœa pes-caprœ*).
Ipomœa spp.

VERBENACEÆ.
Vitex.
Avicennia.

NYCTAGINEÆ.
Boerhaavia diffusa.
Pisonia aculeata.

AMARANTACEÆ.
Alternanthera achyrantha.
Iresine vermicularis.
„ *aggregata.*
Telanthera frutescens.
„ *maritima.*

CHENOPODIACEÆ.
Salsola kali.

LAURINEÆ.
Cassytha?

EUPHORBIACEÆ.
Euphorbia atoto.
Hernandia sonora.
Aleurites moluccana.
Ricinus communis.
Omphalea diandra.

JUGLANDACEÆ.
Juglans?

CASUARINEÆ.
Casuarina equisetifolia.

GNETACEÆ.
Gnetum rumphianum.

CYCADACEÆ.
Cycas.

ORCHIDEÆ.

SCITAMINEÆ.

AMARYLLIDEÆ.
Crinum asiaticum.

TACCACEÆ.
Tacca?

LILIACEÆ.
Dianella ensifolia.

COMMELINACEÆ.
Commelina nudiflora.

PALMÆ.
Cocos nucifera.
Manicaria?
Nipa fruticans.
Orania.
Sagus (Metroxylon).

PANDANACEÆ.
Pandanus.

CYPERACEÆ.
Cyperus.
Remirea maritima.

GRAMINEÆ.
Stenotaphrum americanum.
Sporobolus virginicus.
Imperata arundinaceæ.
Lepturus.
Panicum?

PLANTS PROBABLY DISPERSED BY BIRDS.

The number of plants locally dispersed by birds is undoubtedly very large; and the perfectly sound seeds ejected from the crops of carpophagous birds, which fly long distances, prove the possibility of their being active agents in transporting seeds to distant, or even perhaps very rarely indeed to remote shores. In Polynesia, for example, it is very probable that birds have played an important part in conveying certain seeds from island to island; but that birds ever carry seeds uninjured the enormous distances suggested by Dr Guppy, for instance, seems to us improbable.

On this point we find the following note by Mr Moseley in Wallace's Island Life, p. 250: "Grisebach, Vegetation der Erde, ii. p. 496, lays much stress on the wide ranging of the Albatross (*Diomedea*) across the equator from Cape Horn to the Kurile

Islands, and thinks that the presence of the same plants in Arctic and Antarctic regions may be accounted for possibly by this fact. I was much struck at Marion Island of the Prince Edward group by observing that the great albatross[1] breeds in the midst of a dense low herbage, and constructs its nest of a mound of turf and herbage. Some of the indigenous plants, *e.g.*, *Acæna*, have flower-heads [fruits], which stick like burrs to feathers, &c., and seem specially adapted for transportation by birds. Besides the albatrosses, various species of *Procellaria* and *Puffinus*, birds which range over immense distances, may, I think, have played a great part in the distribution of plants, and especially account, in some measure, for the otherwise difficult fact (when occurring within the tropics) that widely distant islands have similar mountain plants. The *Procellaria* and *Puffinus* in nesting burrow in the ground, as far as I have seen, choosing often places where the vegetation is thickest. The birds in burrowing get their feathers covered with vegetable mould, which must include spores and often seeds. In high latitudes, the birds often burrow near the sea-level, as at Tristan da Cunha and Kerguelen Islands, but in the tropics they choose the mountains for their nesting-place (Finsch and Hartlaub, Ornithologie der Viti- und Tonga- Inseln, 1867, Einleitung, p. 18). Thus *Puffinus megasi* nests at the top of the Korobasa Basaga Mountain, Viti Leon, fifty miles from the sea. A *Procellaria* breeds in like manner in the high mountains of Jamaica, I believe, at 7000 feet. Peale describes the same habit of *Procellaria rostrata* at Tahiti, and I saw the burrows myself amidst a dense growth of fern, &c., at 4400 feet elevation in that island. *Phæthon* has a similar habit. It nests at the crater of Kilauea, Hawaii, at 4000 feet elevation, and also high up in Tahiti. In order to account for the transportation of the plants, it is not of course necessary that the same species of *Procellaria* or *Diomedea* should now range between the distant points where the plants occur. The ancestor of the now differing species might have carried the seeds. The range of the genus is sufficient."

We have already alluded (Part III., p. 313) to Dr Guppy's assumption that it is possible that a seed might be transported by a bird from South Trinidad in the Atlantic to Amsterdam Island in the Indian Ocean. In connection with this, he mentions having found a small hard seed in the gizzard of a Cape pigeon, or Cape petrel, *Daption capensis*, taken about 550 miles east of Tristan da Cunha; a species of bird which he observed a little southward of South Trinidad, and traced as far as Amsterdam Island.

Mr John Murray (*in litt.*) mentions that when birds break their eggs, the matter often hardens on their feet and plumage, and he has seen seeds and small sticks embedded in it; but this happens at a season when birds are unlikely to fly long distances.

From the small collections of seeds and fruits taken from the crops of pigeons by Mr Moseley and Dr Guppy, plants of the following genera or species are known to be dispersed by birds in Polynesia: *Oncocarpus vitiensis*, *Elæocarpus* spp., *Soulamea*

[1] See Narr. Chall. Exp., p. 294, 1885.

amara, Ximenia americana, Eugenia, Psychotria, Premna? Cassytha filiformis, Laurineæ various (including *Litsea*), *Myristica, Phyllanthus, Ficus, Gnetum, Clinogyne grandis, Areca, Kentia,* and *Orania.*

This is a very small list, and is merely offered as an example of what is done by birds. As Dr Beccari, Mr Moseley, and others have pointed out, the fruit-pigeons are able to swallow much larger fruits than would seem possible; and the cassowaries of New Guinea, on the authority of the former, swallow the fruits of *Orania aruensis,* which are two inches and a half in diameter.

EXAMPLE OF AN ISLAND WHICH HAS BEEN LARGELY FURNISHED WITH PLANTS BY OCEANIC CURRENTS AND BIRDS.

In his notes on the vegetation of the Admiralty Islands (reproduced in Part III., pp. 227–231), Mr Moseley gives some particulars of the means by which newly raised coral islands become stocked with plants, and the kinds of trees which successively follow each other. Dr Guppy, too (see Part III., p. 309), and Dr Beccari (*loc. cit.*, p. 312), contribute some interesting facts in relation to the process; and with the evidence we have collected from other sources before us, there is no difficulty in drawing a complete picture of the various phases in the production of an insular flora, such as that of the Arrou or Admiralty Islands, for example. The lists given above might be extended considerably on the assumption that if such and such plants owe their present distribution to these agencies, numerous other plants bearing similar seeds or fruits were dispersed in the same way; but there is no need for speculation, as the evidence is sufficient to account for the vegetation of most of the islands, except those placed in our first category (p. 6), and characterised by having a large endemic element including generic types. From the positions of these islands, it is improbable that birds have effected much, if anything, in stocking them with plants; and the littoral element is almost entirely wanting, in consequence of the nature of the shores being such as to render it impossible for plants to establish themselves thereon.

Taking a very small selection of flowering plants, whose seeds are transported by oceanic currents and birds, we may trace the gradual invasion of an island by herbs, shrubs, and trees. Actual evidence of the germination of drifted grass seeds is wanting, and most of the drift-seeds that certainly retain their vitality, as explained before, are either exalbuminous or have oily albumen; but Darwin's experiments proved that many seeds having farinaceous albumen—those of the oat, for example, will bear long immersion in sea-water without injury to their germinative power. Hence we may assume that the seeds of many almost ubiquitous sand-binding grasses may be reckoned among those which are cast ashore in a vital condition; and we may also assume that these grasses are among the very first flowering plants to obtain a footing. Other herbaceous plants met

with in the earliest stage of such an insular flora are *Portulaca*, *Sesuvium*, *Canavalia obtusifolia*, and *Ipomœa biloba* (*Ipomœa pes-caprœ*); all of which seem to possess an unlimited power of colonisation. Moreover, they provide the conditions necessary for other plants to be able to establish themselves. Among the early shrubby occupants, *Suriana maritima*, *Pemphis acidula*, *Scævola kœnigii*, and *Tournefortia argentea* are prominent, being found on the most remote islets of the Pacific and Indian Oceans, within the tropical and subtropical zones. Where there are muddy shores, there the various mangroves (*Rhizophora*, *Bruguiera*, *Avicennia*, *Vitex*, &c.) take possession. Among the first real trees are, *Heritiera littoralis*, *Hibiscus tiliaceus*, and *Barringtonia speciosa*, together with screw pines. After this nucleus of a flora has been formed, it is comparatively easy for other arrivals to establish themselves; and every addition, in a measure, helps to provide the conditions for a still more varied vegetation. It may be safely assumed, therefore, that if oceanic currents and birds have not been the means of dispersing a large number of species of plants, and it is not certain that they have not, they are certainly the most important agents in stocking islands, for without their action the numerous remote coral islands, at least, would still be utterly devoid of phanerogamic vegetation, and consequently uninhabitable.

Even such plants as epiphytic orchids may owe their presence in an island to the action of the waves, as Mr Moseley observed of one in Little Ki Island (see Part III., p. 306); and in the Philippines he found a young sago-palm that had been washed up growing vigorously just above the ordinary beach-line. Granting that such occurrences may be comparatively rare, still the results in thousands of years might be very great. If an epiphytic orchid survive a sea voyage, why not almost any other plant in the large accumulations of vegetable drift that are carried out to sea by ordinary currents, and driven hither and thither by extraordinary storms?

Broadly speaking, the more remote the island, the fewer and the commoner the species that would be likely to reach it, and such we find to be the case.

As a further example of a flora that owes its existence mainly, if not wholly, as far its phanerogamic element is concerned at least, to oceanic currents and birds, the Bermudan may be named. In Part I., p. 9, will be found a tabular view of the geographical distribution of the vascular plants, probably indigenous, in the Bermudas. Assuming that several of the plants which we have included as probably indigenous owe their presence to the agency of man, there would still remain a considerable number to be accounted for in other ways. We have attempted to classify them according to the most probable means by which they may have reached the islands. Of course there are some fruits and seeds adapted for transport in a variety of ways. There is one possible means by which some of the plants may have reached the islands, concerning which, however, too little is known for us to be able to judge of the extent it has operated, if at all. Like other creatures, birds doubtless sometimes pass portions of their digestible food

undigested, and assuming this, it is possible that some of the small-seeded plants reached the islands through seminivorous birds carried thither by violent storms. The following classification is only offered as a possible solution of the question of transport for each species. Other natural means of dispersal, such as winds, have not been considered, because the object was to bring into prominence what probably might be effected by the ocean and birds alone.

CLASSIFICATION OF THE FLOWERING PLANTS PROBABLY INDIGENOUS IN THE BERMUDAS, ACCORDING TO THE MEANS BY WHICH THEY MAY HAVE BEEN CONVEYED THITHER.

I.—*Chiefly Littoral Plants: Seeds probably conveyed to the Island by Oceanic Currents.*

Cakile æqualis.[1]
Hibiscus tiliaceus.
Suriana maritima.
Elæodendron xylocarpum.
Sapindus saponaria.
Dodonæa viscosa.
Cardiospermum halicacabum.
Rhus toxicodendron.
Sophora tomentosa.
Vigna luteola.
Canavalia obtusifolia.
Centrosema virginianum.
Conocarpus erectus.
Rhizophora mangle.
Opuntia vulgaris.
Sesuvium portulacastrum.
Rhachicallis rupestris.
Chiococca racemosa.
Morinda royoc.
Solidago sempervirens.
Borrichia arborescens.
„ *frutescens.*
Scævola lobelia.
Tournefortia gnaphalodes.
Heliotropium curassavicum.
Ipomœa pes-caprœ.
„ *sagittata.*
„ *villosa.*
„ *acuminata.*
„ *jamaicensis.*
Convolvulus jamaicensis.
Avicennia nitida.
Coccoloba uvifera.
Atriplex cristata.
Salicornia ambigua.
Euphorbia buxifolia.
Croton maritimus.
Ruppia maritima.
Zostera marina.
Cenchrus tribuloides.
Spartina juncea.
Stenotaphrum americanum.
Sporobolus indicus.
„ *virginicus.*
Chloris petræa.

II.—*Marsh Plants: Seeds small, possibly conveyed to the Islands in Mud adhering to Birds.*

Montia fontana.
Ascyrum hypericoides.
Kosteletzkya virginica.
Waltheria americana.
Ludwigia repens.
Hydrocotyle asiatica.
Hydrocotyle umbellata.
Eupatorium fœniculaceum.
Solidago sempervirens.
Baccharis glomeruliflora.
Pluchea odorata.
„ *camphorata.*

Heliotropium curassavicum.
Herpestis monniera.
Atriplex cristata.
Polygonum acre.
Bœhmeria cylindrica.
Ceratophyllum demersum.
Spiranthes tortilis.
Juncus tenuis.
„ *marginatus.*
Typha angustifolia.
Lemna minor.
„ *trisulca.*
Cyperus odoratus.
Cyperus rotundus.
Kyllinga monocephala.
Heleocharis capitata.
„ *melanocarpa.*
„ *plantaginea.*
Dichromena leucocephala.
„ *pura.*
Scirpus lacustris.
Rhynchospora florida.
„ *stipitata.*
Cladium mariscus.
Paspalum distichum.
Spartina juncea.

It is perhaps more probable that many of the foregoing plants reached the islands in the vegetable drift cast ashore during violent storms.

III.—*Plants having more or less Fleshy Fruits: hence probably carried to the Islands by Frugivorous Birds.*

Ampelopsis quinquefolia.
Eugenia monticola.
Opuntia vulgaris.
Randia aculeata.
Psychotria undata.
Forestiera poruloso.
Duranta plumieri.
Coccoloba uvifera.
Peperomia obtusifolia.
Celtis occidentalis.
Myrica cerifera.
Juniperus bermudiana.
Sabal blackburniana.

This list, though the smallest, includes the only Bermudan indigenous trees, and one or two of the commoner inland shrubs. We have no irrefragable evidence of the *Sabal* occurring elsewhere, but even if it be endemic, it can only be a differentiated descendant of the same stock as the species which inhabit the opposite coast of America and the West Indies. The same may be said of *Erigeron darrellianus*, *Statice lefroyi*, *Sisyrinchium bermudiana*, and *Carex bermudiana*.

IV.—*Plants admitted as probably Indigenous, but perhaps equally likely to have been indirectly introduced into the Islands by Man.*

Arenaria alsinoides.
Sida carpinifolia.
Modiola multifida.
Triumfetta semitriloba.
Cardiospermum halicacabum.
Leucœna glauca.
Spermacoce tenuior.
Galium uniflorum.
Eupatorium fœniculaceum.
Solidago stricta.
Pluchea purpurascens.
Eclipta erecta.
Nama jamaicense.
Dichondra repens.
Phryma leptostachya.
Lippia nodiflora.
Stachyharpheta jamaicensis.
Priva echinata.
Urtica chamædryoides.
Parietaria debilis.
„ *pennsylvanica.*
Pilea microphylla.
Paspalum filiforme.
„ *setaceum.*

THE ANTARCTIC FLORA.

ORIGIN OF THE VEGETATION OF THE ISLANDS OF THE SOUTH INDIAN OCEAN.

Many recent writers on phytogeography allude to the American element in Australasian vegetation, and some have recognised the fact that the composition of the flora of the coldest southern zone in which flowering plants grow is essentially the same in all parts; but nobody, except Engler,[1] has very fully discussed this subject. Sir Joseph Hooker (Flora Tasmaniæ: Introductory Essay, pp. 89–91) follows Forster in designating this vegetation "Antarctic;" and he gives a list of species occurring in Australia and New Zealand, or in one or both of these countries, and Kerguelen, Tristan da Cunha, or Fuegia. Grisebach (Vegetation der Erde) defines an "Antarctic Forest Region" in South America, but the vegetation of all the southern islands, including New Zealand, is treated of under the general head of "Oceanic Islands."

Engler (*loc. infra cit.*) divides the vegetation of the earth into kingdoms, and the Antarctic flora is included in his "Old Oceanic Kingdom," which is subdivided into several regions and provinces, and comprises New Zealand, except the northern island, the greater part of Australia, the islands in the South Indian Ocean, South Africa, the Antarctic forest region of South America (which does not embrace the Falklands and Juan Fernandez), and the Tristan da Cunha, St Helena, and Ascension islands. We have not space to discuss the merits of this plan, which we believe the author himself would considerably modify with our data before him; but we agree generally with Drude that insular floras should be attached to the continental ones to which they exhibit the greatest affinity.

Drude (Petermann's Mittheilungen: Ergänzungsheft, No. lxxiv. p. 70) regards Fuegia, the Falklands, South Georgia, South Shetlands, Tristan da Cunha, Prince Edward, the Crozets, St Paul, Amsterdam, Macquarie, and Emerald Islands, as forming a distinct subregion, which he calls the "Antarctic Islands." *Fagus* he looks upon as properly belonging to this subregion and overlapping in other regions. Though this is a much more philosophical method of dealing with the subject than Grisebach's, it is not altogether satisfactory, because the proposed subregion is not correctly limited. It includes either too much or too little. As shown in Part II., pp. 143 and 261, the vegetation of the Tristan da Cunha group, and of Amsterdam and St Paul, consist largely of the same species, and is quite different in its main features (*Phylica* and *Spartina*) from that of Kerguelen and the other islands in a higher latitude. Further, there is no good reason why Macquarie Island should be placed in a different subregion from Auckland and Campbell Islands. Perhaps it would be better to extend this subregion, both in America and New Zealand, in spite of the large endemic element with which the types common to

[1] Versuch einer Entwicklungsgeschichte der Pflanzenwelt; in which work he has tabulated and fully analysed, among others, the floras of Australia and New Zealand.

the whole zone are associated in different parts of it. From our tabular views of the distribution of the plants inhabiting the various groups of islands in the South Indian Ocean, and the sketch of the flora of Macquarie Island a few pages forward, it is quite clear that in the southern, as in the northern hemispere, the only admissible demarcation of the coldest floral region is a zonal one. Proceeding northward in the three great land areas, the differences in the vegetation soon become so pronounced, that it is convenient to treat them as distinct floral regions; yet, apart from the Antarctic types, the relationships of the distribution of other peculiarly southern types is highly interesting, and seems to point to a migration northward, and a former greater land connection in the southern hemisphere. Wallace, while discarding Hutton's theory of a great southern continent uniting New Zealand and Australia with South America, and probably also with South Africa, suggests the probability of a former less interrupted communication between Cape Horn and New Zealand by way of the South Shetland Islands, Graham's Land, "whence the Antarctic continent or a group of large islands probably extends across or around the south polar area to Victoria Land, and thence to Adélie Land." And he assumes that there have been alternations of climate within the Antarctic Circle, as within the Arctic, "during which some portions of the now ice-clad lands became able to support a considerable amount of vegetation." Assuming this to be a correct deduction, the greater difficulties encountered in accounting for the present distribution of plants in the southern hemisphere disappear; for drifting ice and oceanic currents might well have conveyed seeds of the few plants found in the islands of the South Indian Ocean, when they were less isolated from each other than now. And, if we accept Dyer's theory of an original southward migration of the forms of vegetable life from which all the southern ones have been derived, this explanation is sufficient. But the evidence seems to point to a former greater land connection than Wallace admits, and to a northward migration of southern forms which has hardly ceased. Until more conclusive testimony is forthcoming of the former existence of Proteaceæ, *Eucalypti*, &c., in Europe, we cannot avoid the conviction that they originated in the south.

Sir Joseph Hooker, discussing[1] the probable origin of the vegetation of Kerguelen Island, says: "Turning to the natural agents, winds are no doubt the most powerful and sufficient to account for the transport of the cryptogamic spores; these, almost throughout the year, blow from Fuegia to Kerguelen Island, and in the opposite direction only for very short periods, but appear quite insufficient to transport seeds over 4000 miles. Oceanic currents have, doubtless, brought the marine algæ; but the transport of the seeds of the fresh-water plants, of the grasses, and of the two plants with hooked and barbed appendages to the fruit, is not apparent in the case of a country that has no land-birds but an endemic one (*Chionis*), and of which the water-birds come to land only, or chiefly, at the breeding season, and this after long periods of oceanic life in a most

[1] *Philosophical Transactions of the Royal Society of London*, clxviii. p. 13.

tempestuous ocean. Even supposing that the sea-birds which habitually breed in Kerguelen Island did visit Fuegia between the periods of incubation, it is difficult to imagine that any seeds which had adhered to their beaks, feet, or bodies on leaving the latter country would not have been removed by the buffets of winds and waves over upwards of 4000 miles of ocean. The supposition that more land formerly existed along the parallels between Fuegia and Kerguelen Island, possibly in the form of islands, remains as the forlorn hope of the botanical geographer. By such stepping-stones, the land-birds so numerous in the Falkland Islands (which lie in the direction of such hypothetical islands), and of which the vegetation is identical with that of colder South America, favoured by the prevalent westerly gales, have passed from thence to Kerguelen Island, having adhering to them fruits and seeds. The absence of such birds from the present air-fauna of Kerguelen Island offers no obstacle to such a speculation, as such immigrants would on their arrival speedily be destroyed by the predatory gull and petrels of the island."

The following table, showing the connections between the Australasian and South American and African floras, was compiled from various sources, but largely from Engler's work cited above, verified and amplified by the material at Kew.

ON THE RELATIONSHIP BETWEEN THE VEGETATION OF SOUTH AMERICA, AUSTRALASIA, SOUTH AFRICA, AND THE INTERVENING ISLANDS.[1]

Name.	Distribution of the Order, Genus, or Species.
RANUNCULACEÆ.	
Myosurus aristatus	New Zealand, Chili, and California; perhaps introduced in the south.
Ranunculus lyallii	New Zealand species remarkable for their large peltate leaves; the only other similar species being *Ranunculus baurii*, in the Transvaal, South Africa, at an elevation of 5000 feet.
„ *traversii*	
**Caltha*	The section *Psycrophila* is restricted to Australia, New Zealand, and South America.
MAGNOLIACEÆ.	
**Drimys*	New Zealand through Australia to Borneo, and in South America from Cape Horn and Juan Fernandez through the Andes to Mexico.
CARYOPHYLLEÆ.	
**Colobanthus*	Australia, New Zealand, Heard, Kerguelen, St Paul Islands, and Cape Horn to Mexico.
**Colobanthus subulatus*	Australasia and Fuegia.
„ *quitensis*	New Zealand and Cape Horn, through the Andes to Mexico.
Lyallia	Endemic in Kerguelen: nearest affinity, *Pycnophyllum* in the Andes.

[1] Limited to flowering plants; and such genera as *Clematis*, and such species as *Deschampsia cæspitosa*, the distribution of which has no special bearing on the connections between the floras of these regions, are omitted. Australasia is employed to designate Australia, Tasmania, and New Zealand, and the contiguous small islands collectively. Australia, in the remarks on the distribution, may or may not include Tasmania; the latter being used only when that alone, excluding Australia proper, is part of the area. South America includes the Falkland Islands and Juan Fernandez. The genera and species preceded by an asterisk are represented both in Australia proper, or Tasmania and New Zealand.

Name.	Distribution of the Order, Genus, or Species.
PORTULACEÆ.	
**Claytonia*	One species endemic in Australasia, and numerous species in America, from the Antarctic regions to North America.
ELATINEÆ.	
**Elatine americana* . . .	Australasia, Fiji Islands, North and South America.
TILIACEÆ.	
**Aristotelia*	One species in Chili, the rest in Australasia and Polynesia.
GERANIACEÆ.	
**Geranium sessiliflorum* . .	Australasia, Fuegia, and Chili.
**Pelargonium*	Numerous in South Africa and two or three in Australasia, one of which also occurs in Tristan da Cunha.
**Oxalis magellanica* . . .	Australasia, Fuegia, and South Chili.
RHAMNEÆ.	
**Discaria*	One endemic species in New Zealand, one in Australia, and several in South America.
CORIARIEÆ.	
Coriaria thymifolia . . .	New Zealand and South America.
,, *ruscifolia* . . .	New Zealand and adjacent islands, and very common in Chili.
LEGUMINOSÆ.	
**Sophora tetraptera* . . .	Australasia, Polynesia, and South America.
ROSACEÆ.	
**Acæna*	Australasia, Sandwich Islands, all the islands from the Macdonald group and Amsterdam to Tristan da Cunha, Cape Horn to California, and in the Sandwich Islands. **Acæna adscendens* is found in New Zealand and Fuegia, and the islands of the South Indian Ocean.
**Geum*	Allied species in Tasmania, New Zealand, and Fuegia.
Eucryphia	Endemic species in Tasmania, Australia, and Chili.
SAXIFRAGEÆ.	
**Donatia*	One species in Australasia and one in Fuegia.
**Weinmannia*	One species in Tasmania, two in New Zealand, many in South America, especially in the Andes, and several in the Mascarene Islands and Polynesia.
CRASSULACEÆ.	
Tillæa moschata . . .	New Zealand and adjacent islands, Kerguelen, Marion, and Falkland Islands, Fuegia and Chili.
Tillæa verticillata . . .	Australasia and Chili.
DROSERACEÆ.	
**Drosera*	The Australasian *Drosera arcturi* is very nearly related to the Fuegian *Drosera uniflora*.
HALORAGEÆ.	
Haloragis alata . . .	New Zealand and Juan Fernandez.
**Myriophyllum elatinoides* . .	Australia and Chili.
* ,, *variæfolium* .	Australasia and South America.
**Gunnera*	Australasia, South Africa, and America, from Fuegia and Juan Fernandez to Mexico.

Name	Distribution of the Order, Genus, or Species.
MYRTACEÆ.	
**Metrosideros*	One endemic species in South Africa, many in Australasia, and a few in Polynesia. *Metrosideros polymorpha*, common in New Zealand and throughout Polynesia.
ONAGRARIEÆ.	
Fuchsia	Two or three species endemic in New Zealand, and many in America, ranging from Fuegia to Mexico, and one species occurring in the West Indies.
**Epilobium junceun* . . .	Australasia and Chili.
Œnothera	One species of this large otherwise American genus is endemic in the alpine marshes of Tasmania ; it is closely allied to a common American one.
CUCURBITACEÆ.	
**Sicyos angulatus* . . .	Australasia and America on both coasts. A littoral plant, and the only member of the order in New Zealand.
FICOIDEÆ.	
**Tetragonia expansa* . . .	Australasia and South America ; also in Japan.
**Mesembryanthemum æquilaterale*	Australia and Tasmania, and Chili to California ; and closely allied to the South African *Mesembryanthemum acinaciforme*.
* „ *australe* .	Australasia and Polynesia.
„ *crystallinum*	Australia, South Africa, California, and Mediterranean region.
UMBELLIFERÆ.	
**Hydrocotyle americana* . .	New Zealand, North and South America ; and several other species of the two regions are closely related.
**Pozoa*	New Zealand, Tasmania, and South America.
**Azorella*	Australasia, Macdonald group, and intervening islands to Marion, and South America.
Huanaca	Two Australian species, and four extratropical South American ; and one is recorded from Mexico.
Azorella selago	Marion to the Macdonald group, and in Macquarie Island and Fuegia.
**Crantzia lineata* . . .	Australasia and Chili to the United States.
**Apium australe* . . .	South temperate and cold regions generally.
**Oreomyrrhis*	Australasia and America, from Chili to Mexico, with endemic species in both regions.
„ *andicola*. . .	Australasia and the Andes, northward to Mexico.
**Daucus brachiatus* . . .	Australasia and America.
CORNEÆ.	
Griselinia	Endemic species in New Zealand, Chili, and Brazil.
RUBIACEÆ.	
**Nertera*	New Zealand to Java and the Philippines, Tristan da Cunha and Fuegia to Mexico, with endemic species in each region.
**Nertera depressa* . . .	Australasia, Tristan da Cunha, Fuegia to Mexico, and in the Sandwich Islands.
**Coprosma*	Numerous in New Zealand and extending northward to Borneo, throughout Polynesia, and one endemic species occurs in Juan Fernandez.

Name.	Distribution of the Order, Genus, or Species.
COMPOSITÆ.	
**Lagenophora*	Australasia to India and the Sandwich Islands, with a few species in South America, one of which reaches Tristan da Cunha.
**Abrotanella*	Several species in Australasia and one in the Falklands.
Cotula plumosa	Crozets, Kerguelen, Macquarie, Auckland, and Campbell Islands.
Flaveria	Seven species, six of which inhabit America, ranging from Chili to Mexico and Florida, and one Australia, the Australian species being very near one of the commoner American ones.
**Microseris*	A genus of about a dozen species, whereof one is found in Extratropical South America, one in Australasia, and the rest in North-west America.
STYLIDEÆ.	
**Phyllachne*	Australasia and Fuegia.
LOBELIACEÆ.	
**Lobelia anceps*	Australasia, South America, and South Africa.
**Pratia*	Endemic species in Australasia, South America, and Asia.
**Selliera radicans* . . .	Australasia and Chili.
ERICACEÆ.	
**Pernettya*	One species endemic in Tasmania and New Zealand, and the rest in South America.
*ERICACEÆ, sub-ord. EPACRIDEÆ .	Restricted to Australasia, Polynesia, Malayan Peninsula and Archipelago, except the monotypic *Lebetanthus americanus*, and specially numerous in Australia.
PRIMULACEÆ.	
**Samolus repens* . . .	Australasia, Polynesia, and South Chili.
GENTIANACEÆ.	
**Gentiana saxosa* . . .	The only species found in Australia, with which Mueller unites the South American *Gentiana magellanica*.
CONVOLVULACEÆ.	
Calystegia tuguriorum . .	New Zealand, Masafuera, Chili.
SCROPHULARINEÆ.	
Calceolaria	Two endemic species in New Zealand, and many in America, ranging from the Falklands and Fuegia to Mexico.
**Gratiola peruviana* . . .	Australasia and South America.
Veronica elliptica . . .	Australasia, Falklands, and Fuegia.
Ourisia	One species endemic in Tasmania, about six in New Zealand, and about a dozen in America, ranging from Fuegia to New Grenada.
PLANTAGINEÆ.	
**Plantago*	*Plantago brownii*, found in Tasmania and New Zealand, has a representative species in the South American *Plantago barbata*.
**Euphrasia antarctica* . .	Australasia and Chili.
POLYGONEÆ.	
**Muehlenbeckia*	Endemic species in Australasia and in the Andes.

Name.	Distribution of the Order, Genus, or Species.
MONIMIACEÆ.	
Laurelia	One species endemic in New Zealand, and one in Chili.
PROTEACEÆ.	Chiefly endemic genera in the Australasian, African, and American regions: in Asia, *Helicia* extends northward to Japan; in Africa a few members of the order reach Abyssinia and Madagascar, and in America *Roupala* reaches Mexico. None eastward of New Caledonia and New Zealand in Polynesia.
Roupala	Two or three species in New Caledonia, and the rest (about thirty) in America.
Lomatia	About half-a-dozen species in Eastern Australia, and three in Chili.
Embothrium	One species endemic in Eastern Australia, and the rest (four) in America, ranging from Magellan Strait to Peru.
Orites	One species endemic in Chili, and the rest in Australia.
THYMELÆACEÆ.	
**Drapetes*	Three Australasian species, one Bornean, and one Fuegian.
CUPULIFERÆ.	
**Fagus*	The section *Nothofagus* is restricted to Australasia and South America, with endemic species in Australia, New Zealand, Fuegia, and Chili. In Australia the genus reaches the head of the Mackay River, New South Wales.
CONIFERÆ.	With the exception of *Saxegothea*, all the South American genera of this order are also represented in Australasia.
**Podocarpus*	The New Zealand *Podocarpus spicata*, and the American *Podocarpus andina*, are closely allied.
Araucaria	The section *Columbea* is represented by endemic species in New Caledonia, Eastern Australia, Chili, and Brazil.
Libocedrus	New Zealand, New Caledonia, China, Japan, Chili, and California.
Fitzroya	One species endemic in Chili, and the only other (*Diselma*) in Tasmania.
**Dacrydium*	Australasia, Malaya, Polynesia, and Chili.
IRIDEÆ.	
**Libertia*	Endemic species in Australia, New Zealand, and Fuegia.
NAIADACEÆ.	
**Triglochin striatum* . . .	North and South America, South Africa, and Australasia.
LILIACEÆ.	
Luzuriaga	Two species endemic in Chili, and one (*Callixene*) in Fuegia and New Zealand.
**Astelia*	Chiefly New Zealand, and represented in Fuegia, South-eastern Australia, and the Sandwich Islands.
JUNCACEÆ.	
**Juncus planifolius* . . .	Australia, New Zealand, and western coast of South America, from Chili to Bolivia.
**Juncus vaginatus* . . .	Tasmania and New Zealand, and very closely allied to the Chilian *Juncus procerus*.
**Juncus scheuchzerioides* . .	Australasia, Kerguelen, Fuegia.

Name.	Distribution of the Order, Genus, or Species.
**Luzula crinita*	Auckland, Campbell, and Macquarie Islands, and closely allied to the Fuegian *Luzula alopecurus*.
Rostkovia magellanica . .	Campbell Island and the Falklands, and Fuegia to the Andes of Quito.
*Restiaceæ.	This Order is almost confined to Australia and South Africa; very few occur in New Zealand, one in Cochin-China, and one only in South America. The African and Australian genera are mostly distinct.
**Leptocarpus*	Of the nineteen species described, ten are from Australia, one from New Zealand, one from Chili, one from Cochin-China, and seven from South Africa.
Restio	There are about 100 species of this genus, twenty-two of which are endemic in Australia, and the rest in South Africa.
Hypolæna	Five species have been found in Australia, one of which extends to New Zealand; the rest (about a dozen) are endemic in South Africa.
Centrolepideæ.	
**Gaimardia*	One endemic species each in New Zealand, the Auckland Islands, and Chili.
Cyperaceæ.	
**Oreobolus*	Two or three closely allied species inhabit Australia, New Zealand, and Chili; and Mann describes one from the Sandwich Islands.
**Oreobolus pumilio* . . .	Tasmania, New Zealand, and Chili.
**Carpha*	Two species, one inhabiting Australia and New Zealand, and the other Fuegia and Chili.
**Schœnus*	The New Zealand *Schœnus pauciflorus*, and the Chilian *Schœnus antarcticus*, are very closely related.
**Scirpus nodosus* . . .	Australasia, St Paul Island, South Africa, St Helena, and Extratropical South America.
Scirpus riparius . . .	Australasia, South Africa, and South America, and very near the widely spread *Scirpus setaceus*.
Scirpus aucklandicus . . .	New Zealand, Amsterdam Island, and South America.
Carex trifida	New Zealand and the adjacent islands, the Falklands, and Fuegia.
**Uncinia*	Australia and New Zealand; through the islands in the southern part of the Indian Ocean to the Tristan da Cunha group, the Falklands, Fuegia, and northward through the Andes to Mexico and the West Indies; and one is found in the Sandwich Islands.
Gramineæ.	Several of the Gramineæ of the Australasian and South American regions are very closely allied, and **Hierochlœ redolens* and **Agrostis magellanica* (*Agrostis antarctica*) occur in both.

The total number of species in the foregoing table inhabiting both Australasia and South America is forty-eight, and the number of other essentially southern genera represented in the two regions by closely related species is forty-nine. These numbers are small in comparison with the total number of genera and species inhabiting Extratropical Australasia and Extratropical South America; but their significance is more apparent when we reflect that these genera and species are chiefly confined to New Zealand, the contiguous islands, and the mountain flora of Victoria and Tasmania, and that all the species of wider distribution common to the two countries are omitted. Forty-six out of

these forty-eight species, and thirty-six out of the forty-nine genera of which there are representative species in the two regions, occur in New Zealand. Including vascular cryptogams, of which there are 138, Engler tabulates 1094 species of New Zealand plants, of which 671 are endemic. Another point to consider is the individual prominence of the species and genera in question. Taking *Fagus* and the coniferous genera, we find that they constitute the principal forests of the colder regions of the two countries. The distribution of the Epacrideæ, Proteaceæ, and Restiaceæ, deserves special study, as they belong chiefly to the warm temperate parts of the three areas, generally speaking; only two species of Proteaceæ inhabit New Zealand, however, and one each of Epacrideæ and Restiaceæ South America.

The Falkland Islands flora, which Engler separates from his "Old Oceanic Floral Kingdom," is essentially Fuegian, and richer in endemic species than the Auckland, Campbell and Macquarie Islands, near New Zealand.

DISTRIBUTION OF FALKLAND ISLANDS FLOWERING PLANTS.[1]

Name.	Distribution.
Ranunculaceæ.	
**Ranunculus biternatus*	Fuegia, Kerguelen.
,, *maclovianus*	Endemic.
,, *sericocephalus*	Endemic.
,, *hydrophilus*	Endemic.
,, *trullifolius*	Endemic.
Hamadryas argentea	Endemic.
**Caltha sagittata*	Fuegia, Port Famine, and Hermite Island.
,, *appendiculata*	Fuegia, Port Famine, and Hermite Island.
Cruciferæ.	
Arabis macloviana	Endemic.
**Cardamine hirsuta*	Very widely diffused.
Draba falklandica	Endemic.
Violarieæ.	
**Viola maculata*	Magellan Strait.
,, *tridentata*	Staten Land, Port Famine, Hermite Island.
Droseraceæ.	
**Drosera uniflora*	Fuegia, Port Famine, Magellan Strait.
Caryophylleæ.	
Sagina procumbens	Very widely diffused.
**Colobanthus subulatus*	Good Success Bay, Hermite Island, Australasia.
,, *crassifolius*	Magellan Strait, Port Famine.
**Stellaria debilis*	Staten Land.
Cerastium arvense	Widely diffused.

[1] From Hooker's Flora Antarctica, ii., with fuller distribution added. A few additional species have been collected in the islands since the publication of this work, we believe. The genera preceded by an asterisk are also represented in New Zealand.

Name.	Distribution.
GERANIACEÆ.	
**Oxalis enneaphylla*	Endemic.
ROSACEÆ.	
**Rubus geoides*	Magellan Strait, Port Famine.
**Acœna lucida*	Endemic.
„ *lævigata*	Magellan Strait, and Hermite Island.
„ *adscendens*	Fuegia, South Georgia, Kerguelen, and New Zealand.
ONAGRARIEÆ.	
**Epilobium tetragonum*	Widely diffused.
HALORAGEÆ.	
**Myriophyllum elatinoides*	Chili, Andes, New Zealand, Australia.
**Callitriche verna*	Widely diffused.
**Gunnera magellanica*	Fuegia; South Chili.
MYRTACEÆ.	
**Myrtus nummularia*	Fuegia and South Chili.
PORTULACEÆ.	
**Montia fontana*	Very widely spread.
CRASSULACEÆ.	
**Tillœa moschata*	Southern cold temperate zone.
UMBELLIFERÆ.	
**Azorella cœspitosa*	Magellan Strait, Port Gregory.
„ *filamentosa*	Magellan Strait, Port Famine, &c.
„ *lycopodioides*	Fuegia, Port Famine, &c.
„ *ranunculus*	Endemic.
Bolax glebaria	Fuegia, Good Success Bay, and Hermite Island.
**Apium australe*	South temperate and cold temperate zones.
**Crantzia lineata*	South temperate and cold temperate zones and Andes.
**Oreomyrrhis andicola*	Chili, Andes to Mexico, and in Australasia.
RUBIACEÆ.	
**Galium antarcticum*	Fuegia; Staten Land; Crozets; Kerguelen Island.
**Nertera depressa*	Chili, through the Andes to Mexico, Tristan de Cunha, New Zealand, &c.
COMPOSITÆ.	
Chiliotrichum amelloides	Fuegia and South Chili.
Aster vahlii	Fuegia and South Chili.
**Lagenophora commersonii*	Fuegia, South Chili, and Tristan da Cunha.
Baccharis magellanica	Fuegia.
**Abrotanella emarginata*	Magellan Strait, Port Famine, &c.
**Gnaphalium spicatum*	Widely spread in South America.
„ *antarcticum*	Endemic.
**Senecio candidans*	Fuegia.
„ *falklandicus*	Endemic.
„ *littoralis*	Endemic.
Chevreulia lycopodioides	Endemic

Name.	Distribution.
Nassauvia serpens	Endemic.
„ *gaudichaudii*	Fuegia, Magellan Strait.
Chabræa suaveolens	Endemic.
Homoianthus echinulatus	Magellan Strait, Ports Famine and Gregory.
Achyrophorus arenarius	Magellan Strait, Port Gregory.
**Taraxacum dens-leonis*	Generally diffused.
Macrorhynchus pumilus	Endemic.
Hieracium antarcticum	Patagonia.
LOBELIACEÆ.	
**Pratia repens*	Fuegia, Staten Land.
ERICACEÆ.	
**Pernettya pumila*	Fuegia and South Chili.
**Gaultheria microphylla*	Fuegia, Magellan Strait, &c.
GENTIANACEÆ.	
**Gentiana magellanica*	Fuegia, Magellan Strait. Hardly different from the Australasian *Gentiana saxosa*.
SCROPHULARINEÆ.	
**Calceolaria fothergillii*	Magellan Strait, Port Famine.
„ *polyrhiza*	Patagonia.
**Limosella aquatica*	Widely dispersed.
**Veronica elliptica*	Magellan Strait to Cape Horn and New Zealand.
PRIMULACEÆ.	
Primula magellanica[1]	Magellan Strait to Cape Horn.
Anagallis alternifolia	Magellan Strait, Port Famine.
PLUMBAGINEÆ.	
Statice armeria	Fuegia, Patagonia, and in the northern hemisphere.
PLANTAGINEÆ.	
**Plantago monanthos*	Hermite Island, Cape Horn.
CHENOPODIACEÆ.	
**Chenopodium macrospermum*	Endemic.
SANTALACEÆ.	
Nanodea muscosa	Fuegia, Magellan Strait.
THYMELÆACEÆ.	
**Drapetes muscosa*	Fuegia, Magellan Strait.
EMEPETRACEÆ.	
Empetrum rubrum	South Chili, Fuegia, and Tristan da Cunha.
ORCHIDEÆ.	
Chlorœa gaudichaudii	Endemic.
Asarca commersonii	Magellan Strait.
„ *odoratissima*	Chili.
Codonorchis lessonii	Fuegia and Magellan Strait.

[1] Sir Joseph Hooker now regards this as specifically distinct from *Primula farinosa*, to which he reduced it in the Flora Antarctica. See *Journ. Linn. Soc. Lond.*, xx. p. 2.

Name.	Distribution.
Irideæ.	
Sisyrinchium filifolium	Cape Gregory and Magellan Strait.
Liliaceæ.	
**Callixene marginata*	Fuegia.
**Astelia pumila*	South Chili, from the Chonos Archipelago to Cape Horn.
Juncaceæ.	
**Rostkovia grandiflora*	Throughout Fuegia.
„ *magellanica*	Magellan Strait to Cape Horn, and in Campbell Island.
**Juncus scheuchzerioides*	Widely spread in the southern cold temperate zone.
**Luzula alopecurus*	Magellan Strait. Closely allied to the New Zealand *Luzula crinitus*.
Naiadaceæ.	
**Triglochin magellanicum*	Magellan Strait to Cape Horn.
Centrolepideæ.	
**Gaimardia australis*	Fuegia.
Cyperaceæ.	
**Oreobolus obtusangulus*	Fuegia.
**Eleocharis palustris*	Widely diffused.
**Isolepis pygmæa*	South Chili.
**Carex ovalis*	Widely spread.
„ *curta*	Widely spread, including Fuegia.
„ *acaulis*	Endemic.
„ *decidua*	Fuegia.
„ *indecora*	Endemic.
„ *trifida*	Cape Tres Montes, Australia, and New Zealand.
**Uncinia macloviana*	Endemic, but very closely allied to species in the islands from Tristan da Cunha to Kerguelen.
Gramineæ.	
**Alopecurus alpinus*	Fuegia and northern hemisphere.
**Agrostis alba*	Very widely spread.
„ *prostrata*	Endemic.
„ *falklandica*	Endemic.
„ *antarctica*	South Chili, Fuegia, Kerguelen Island, and New Zealand.
**Arundo pilosa*	Endemic.
**Hierochloe magellanica*	Throughout Fuegia.
Aira flexuosa	Fuegia and northern hemisphere.
„ *antarctica*	Fuegia, Kerguelen's Land.
**Trisetum subspicatum*	Widely spread in south temperate zone.
**Festuca arundo*	Fuegia.
„ *antarctica*	Endemic.
„ *arenaria*	Magellan Strait, Port Famine.
„ *magellanica*	Magellan Strait, Port Famine.
Dactylis cæspitosa	Throughout Fuegia.
Triticum repens	Widely diffused.

Total, 115 species belonging to eighty-four genera, fifty-six of which are represented in New Zealand. Here, as in the islands contiguous to New Zealand, there is no endemic genus; but the endemic species number twenty-six, or 22·6 per cent. of the whole. Leguminosæ are wholly wanting, as they are, we believe, in Fuegia. A very few have been collected at Port Famine, Port Gregory on the opposite side of Magellan Strait, and one in Elizabeth Island in the Strait. We have already alluded to the absence or great rarity of Leguminosæ in insular floras where there is no littoral element, but the flora of the colder southern regions generally is exceptionally poor in this order. In the Arctic regions there are at least thirty-four species, belonging to twelve genera.

In Sir James Ross's Narrative of his Antarctic Voyage (ii. p. 293) are the following remarks by Sir J. D. Hooker on the vegetation of the extreme south of America: "As Hermite Island is situated close to Cape Horn (56° S. lat.), a list of the indigenous plants is given. Only four species of flowering plants reach the top of Mount Kater, a peak of greenstone 1700 feet above the sea, and the culminant point of the island. They are: *Azorella selago*, *Abrotanella emarginata*, *Pernettya pumila*, and *Empetrum rubrum*. The following species reach an elevation of 1500 feet on the same or neighbouring peaks: *Viola tridentata*, *Saxifraga bicuspidata*, *Escallonia serrata*, *Azorella lycopodioides*, *Ourisia breviflora*, *Drapetes muscosa*, *Fagus antarctica* (only three inches long), *Luzula* sp., *Triodia antarctica*, *Aira parvula*, and *Festuca erecta*." In the place cited are particulars of the flora of the lower part of the island, where vegetation is relatively varied and luxuriant. Extensive forests of beech (*Fagus fosteri* and *Fagus antarctica*) exist, intermingled with *Drimys winteri*, and a sparse undergrowth of *Berberis ilicifolia*, *Veronica elliptica*, &c. Among the genera of herbaceous plants represented are: *Caltha*, *Astelia*, *Forstera*, *Donatia*, *Pinguicula*, *Primula*, *Senecio*, *Carex*, and *Juncus*.

THE FLORA OF MACQUARIE ISLAND.

No endemic flowering plant or fern has been collected in Macquarie Island. Nevertheless the flora clearly belongs to the same category as the Crozets, Kerguelen, Auckland, &c., between which, as we believe, there was formerly a closer land connection. Great interest attaches to the botany of this island, on account of its being the most southerly land known to support phanerogamic vegetation at the present time, if we except the Archipelago at the southern extremity of America and the South Shetlands, in about 62° S. lat., where one flowering plant, *Aira antarctica*, was collected by Dr Eights, and is preserved in the Kew Herbarium. At Cockburn Island, in 64°, Sir J. D. Hooker found only cellular cryptogams.[1]

South Georgia, which lies in about the same latitude as Macquarie, but nearly on the

[1] See Sir James Ross's Voyage in the Southern and Antarctic Regions, ii. p. 335.

opposite side of the globe, and about 1000 miles east of Cape Horn, was covered with perennial snows and the harbours blocked up with everlasting glaciers, still Captain Cook found a scanty vegetation, consisting of "a coarse strong-bladed grass, growing in tufts, a wild burnet [most likely a species of *Acæna*], and a moss-like plant which springs from the rocks."[1]

In the Kew Herbarium there are specimens of only seven species of flowering plants and one fern from Macquarie Island, which were sent by Mr Fraser of the Sydney Botanic Garden about fifty years ago. They are: *Acæna sanguisorbæ*, *Acæna adscendens*, *Azorella selago*, *Pleurophyllum criniferum*, *Cotula plumosa*, *Luzula crinita*, and *Aspidium aculeatum*, var. *vestitum*.

But now, thanks to the zeal with which botany is pursued at the antipodes, we have a general knowledge of the flora. Towards the end of 1880, Dr J. H. Scott of the Otago University availed himself of an opportunity to visit the island and investigate its natural history; and he published the results in the Transactions of the New Zealand Institute (xv. p. 484), from which we extract some passages of special interest, as well as the list of plants collected, merely adding the distribution of the species in full, as we were unaware of the existence of Dr Scott's paper before it was too late to give this information elsewhere.

Macquarie Island lies about 600 miles to the south-west of New Zealand, more than twice as far away as the Auckland group, and is separated from that group and from Campbell Island by very much deeper water than that which lies between them and New Zealand. There is a great valley 3000 fathoms deep between Macquarie Island and the Auckland and Campbell Islands, while the sea between them and New Zealand is not 1000 fathoms deep. It is situated between 54° 26′ and 54° 44′ S. lat., and 159° 5′ 45″ and 159° 1′ 45″ E. long., being about eighteen miles long and five miles broad. The surface is hilly, though the greatest height is probably not more than 600 or 700 feet. The interior of the island shows the rocky tops of the hills blown perfectly bare by the wind, and fissured by the frosts; and in the hollows of the uplands lie a number of little lakes, which empty themselves by streams. These either make valleys for themselves, or tumble down the steep hill-sides in miniature cascades. The general appearance of Macquarie Island is barren in the extreme; not a tree nor a shrub on the island, and what vegetation there is has a great deal of sameness; long stretches of yellowish tussock (*Poa foliosa*), with occasional large patches of *Stilbocarpa polaris*, or of the peculiar sage-green *Pleurophyllum*. These, with the rich brown mosses near the hill-top, are all that strike the eye in looking at the island from the sea. *Azorella selago* grows on the hill-sides, forming prominent globular masses often four feet across. These are green on the surface, where the living part of the plant lies as a crust to the great mass of *débris* of former years' growth, through which the roots descend. The whole is so solid that one can stand upon it, and the surface so

[1] See Hooker's Flora Antarctica, p. 216.

uniform and dense that lichens and other small plants are sometimes found growing upon it. *Pleurophyllum criniferum*, collected in flower and fruit, is the handsomest plant on the island; its long sage-green leaves and purple flowers making it very prominent. *Stilbocarpa polaris*, the Macquarie Island cabbage of the sealers, was also collected in flower and fruit. In sheltered corners in the lower ground it is a handsome plant, and its bright green leaves are always conspicuous. Many of the plants collected were not in flower, hence the species could not always be determined with certainty. The visit was made in November, when the spring is little advanced in that latitude; and Dr Scott does not regard his collection as being complete, though he doubts the existence of any other noteworthy plants. In the ensuing list the distribution of the genuine plant is given, even when the Macquarie Island specimen was not identified with certainty.

Name.	Distribution.
RANUNCULACEÆ.	
Ranunculus acaulis, Banks and Sol.?	New Zealand and Auckland group.
CARYOPHYLLEÆ.	
Colobanthus muscoides, Hook. f.	Auckland and Campbell Islands.
ROSACEÆ.	
Acæna buchanani, Hook. f.	New Zealand.
„ *adscendens*, Vahl.	New Zealand, Fuegia, Falklands.
CRASSULACEÆ.	
Tillæa sinclairii, Hook. f.	New Zealand.
UMBELLIFERÆ.	
Azorella selago, Hook. f.	Marion, Crozets, Kerguelen and Heard Islands, and Fuegia.
„ *lycopodioides*, Gaud.?	Fuegia and Falkland Islands.
ARALIACEÆ.	
Stilbocarpa polaris, Dcne. and Planch.	New Zealand, Auckland and Campbell Islands.
RUBIACEÆ.	
Coprosma repens, Hook. f.	New Zealand, Auckland and Campbell Islands.
COMPOSITÆ.	
Pleurophyllum criniferum, Hook. f.	Auckland and Campbell Islands.
Cotula plumosa, Hook. f.	Auckland and Campbell Islands, the Crozets, and Kerguelen Islands.
JUNCACEÆ.	
Luzula crinita, Hook. f.	Auckland and Campbell Islands.
„ *campestris*, Linn.	Temperate regions generally.
GRAMINEÆ.	
Poa foliosa, Hook. f.	New Zealand, Auckland and Campbell Islands.
„ *annua*, Linn.	Northern hemisphere, and now widely colonised.
Festuca duriuscula, Linn.	Widely spread in temperate regions.

Name.	Distribution.
FILICES.	
Aspidium aculeatum, Swartz, var. *vestitum*, Hook.	This variety is found in New Zealand, Australia, Tasmania, and Fuegia.
Polypodium australe, Mett.	General in south temperate zone.
Lomaria alpina, Spreng.	South temperate zone, including the islands of the Southern Indian Ocean, though hitherto not recorded from the Auckland and Campbell Islands.

Besides the foregoing vascular plants, Dr Scott collected twenty-one species of cellular cryptogams. Disregarding *Poa annua*, which Scott thinks may have been introduced, as it was only found near one of the sealers' huts, there are eighteen vascular plants, whereof twelve are also found in New Zealand, and of these two were previously only known from New Zealand, and four only from New Zealand and the Auckland and Campbell Islands; while of the remaining six, three are only known to inhabit the Auckland, Campbell, and MacquarieIs lands; one is restricted to these islands, the Crozets and Kerguelen Islands; finally, the genus *Azorella* is not represented in New Zealand, or any of the other adjacent islands.

CONCLUDING REMARKS.

Bermudas.—The composition of the flora of these islands so clearly indicates its origin, and the means by which the majority of the species reached the islands are so obvious, that it would be superfluous to adduce further evidence thereon; but it may be mentioned, in connection therewith, that there is a much greater overlapping of the West Indian flora in South Florida than was formerly supposed. Many of the indigenous Bermudan plants are very rare; some probably through cultivation; others, perhaps, on account of being late arrivals.

Fernando-Noronha.—As the main island of this group is still botanically almost unknown, it is impossible to say whether there be any generic endemic element, though from the sample of the flora collected in the adjacent islets by Mr Moseley, it is not probable that any exists. Associated with a number of very common plants, are a few apparently endemic species of common American genera. The most noteworthy point in connection with the vegetation is the apparent total absence of ferns and mosses.

Ascension.—Whether this island ever supported anything more than its present extremely meagre flora is problematical; but the presence of two distinct endemic species of flowering plants belonging to widely diffused genera, is no help to the solution of the problem. The one, *Hedyotis adscensonis*, is not very different from African and Asiatic species; and the other, *Euphorbia origanoides*, belongs to a group of littoral, mostly shrubby species, widely spread in Polynesia, with one species in the West Indies and the

Bermudas, and two on the western coast of Tropical Africa. Two St Helena endemic plants (see Part II., p. 34) are recorded from Ascension, but there are no specimens in the London Herbaria corroborating this, and it is almost certain that there was some mistake.

St Helena.—In common with that of Juan Fernandez and some other islands, the endemic element of the flora of St Helena includes a considerable proportion of arboreous Compositæ, the origin of which seems to be more remote and uncertain than that of the rest. We have entered at some length into the distribution of arboreous Compositæ generally, without, however, arriving at any even probable solution of the problem of how they reached these islands. Unlike the remainder of the element, the arboreous Compositæ of St Helena and Juan Fernandez are, to say the least, not more closely allied to the Compositæ of the nearest continents than they are of some more distant regions. The St Helena Compositæ, for example, exhibit quite as close a relationship to certain South American and Australian genera as they do to African; and the Juan Fernandez Compositæ exhibit no less distinct affinities. In Chili the characteristic and prevailing tribe of Compositæ is the Mutisiaceæ, which form, according to Bentham, nearly a third of the whole number; yet this tribe is not represented in Juan Fernandez; but what is more singular, the only Mutisiaceous genus in the Pacific islands is the very rare, monotypic, endemic, arboreous *Hesperomannia* in the distant Sandwich Islands. On the other hand, the remarkable Cichoriaceous Juan Fernandez genus *Dendroseris* has no near relative in Chili, where the tribe is sparsely represented. With regard to the very distinct Tahitian genus *Fitchia*, Sir Joseph Hooker acquiesces in the propriety of placing it in the Helianthoideæ rather than the Cichoriaceæ, in spite of its ligulate flowers. The occurrence of arboreous Compositæ in so many remote oceanic islands, coupled with the distribution of the genera to which they bear the greatest affinity, seems to indicate that they are the remains of very ancient types. We have not discussed the probabilities of differentiation on the spot, because, even assuming that to have happened, the difficulties connected with the great isolation of the insular types and their nearest continental affinities have still to be met. The question by what means the ancestors of these Compositæ were conveyed to the islands—and unless a former continental connection be supposed, conveyance from a continent seems the inevitable conclusion—can only be conjecturally answered. Most of the Compositæ are provided with exceptionally favourable means of dispersion in their light pappose achenes, though perhaps not for conveyance over immense expanses of the ocean; but we have yet much to learn on this point. Wind seems at first the most probable agent; but an uninterrupted current of air necessary for the purpose is hardly imaginable; and then, it might be asked, why has the agency, whatever it was, ceased acting? and why have its operations been limited to the conveyance of seeds to the islands? why not from the islands as well?

South Trinidad.—This island was covered, in parts at least, with wood, even as late as the middle of the present century. Now the trees are all, or nearly all, prostrate and dead; and the living vegetation, as far as known, is restricted to about a dozen species of flowering plants and ferns; but it has not been explored by a botanist. Independently of the existing vegetation, it would be interesting to ascertain the relationship of the trees which formerly clothed the hill-sides. The few plants known are distinctly Brazilian in character, with the exception of one fern, which had previously only been collected in St Helena.

Tristan da Cunha Group, and St Paul and Amsterdam Islands.—These two distant groups are coupled, because, as already explained, the plants forming the mass of the vegetation are of the same species in both cases. They are only two in number. One is a stout reed (*Spartina arundinacea*), which is confined to these islands, and has its nearest ally in a South-eastern American species; and the other is *Phylica nitida*, a shrub or small tree, also found in the Mascarene Islands, and belonging to a genus numerously represented in Extratropical South Africa, with a few species in Madagascar, and one endemic species in St Helena, and unknown elsewhere. The distribution of *Phylica nitida* is specially remarkable, inasmuch as it is unknown in Africa, and perhaps as nearly related to the St Helena species as any. The small number of other flowering plants in these two groups of islands consists partly of endemic species of genera more or less widely diffused in the south temperate zone or beyond, and partly of species of wider range.

The Chain of Islands from the Prince Edward Group to the Macdonald Group.—From our analysis of the distribution of the vascular plants found in these islands (Part II., p. 250), it will be seen, that in spite of the great distances separating the groups, the vegetation is essentially the same throughout, and a part of that characteristic of the coldest southern region of flowering plants generally. These facts, considered in relation to the means by which the plants might be dispersed, all point to a former great land-connection, and this is the view taken by Sir Joseph Hooker and Mr Moseley. Further, the fuller details of the Antarctic Flora a few pages back confirm the close relationship existing between the vegetation of the most distant points of the coldest southern region. The Antarctic drift and other agencies may possibly have conveyed the seeds of the plants growing in the chain of islands under consideration. Wallace employs all the evidence adducible to prove a former land-connection between New Zealand and Australia by way of Lord Howe's Island, and doubtless his arguments are sound; but he is content, perhaps from having less deeply studied this part of the subject, with a comparatively broken connection with America to account for the American element in New Zealand. The extreme poverty of the present vegetation of the islands in the South Indian Ocean might be put forward as an argument in favour of original isolation; but the evidence of

the vegetation of the past, slight as it is, favours the opposite view. Fossil wood has been found in the Crozets and Kerguelen; and specimens brought from the latter island by Sir Joseph Hooker and others were regarded by the late Dr Gœppert as being related to *Araucaria*, and he named them *Araucarites schleinitzii*, and *Araucarites hookeri*.

Juan Fernandez and Masafuera.—This little flora is as remarkable for what it does not contain as for what it does contain. Apart from the Compositæ, mentioned above under St Helena, the flora is essentially Chilian in character, a large proportion of the endemic element being species of genera also represented in Chili; yet the large characteristic Chilian genera of Leguminosæ, Compositæ, Orchideæ, &c., are entirely absent from the islands. The Boragineous genus *Selkirkia* has, however, no great affinity with any Chilian member of the order, and *Lactoris* is altogether an isolated type of a tribe of Piperaceæ.

The South-eastern Moluccas.—So far as we know, the vegetation of these islands contains only a very small endemic element, though larger than that in the Bermudas. Dr Beccari, who has more thoroughly explored the botany of the Arrou Islands than Mr Moseley was able to, describes it as exceedingly poor and wholly Papuan; and he finds evidence of a comparatively recent connection with New Guinea.

The Admiralty Islands.—The fragment of the flora of this group on the extreme western edge of Polynesia, collected by Mr Moseley, shows, as might be expected, that the vegetation is intermediate in character between the Malayan and Polynesian. In Polynesia, as elsewhere, the Compositæ more particularly are perplexing to the botanical geographer, for although they have their greatest affinities in America, as well as the subarboreous Lobeliaceæ, so numerous in the Sandwich Islands, yet the bulk of the vegetation seems to have been derived from the Australo-Asiatic region. As suggested before, perhaps the arboreous Compositæ are older than the other constituents of the vegetation. The Australasian genus *Metrosideros* penetrates as far eastward as Pitcairn, where, as in the Sandwich Islands, it forms large woods; and the prominence of such other Australasian or Asiatic genera in the Sandwich Islands as *Pittosporum*, *Alphitonia*, *Cyathodes*, *Scævola*, and *Cyrtandra* is noteworthy. On the other hand, the peculiar Sandwich Island types seem to have had a former wider extension, as is indicated by the Lobeliaceous arboreous genus *Sclerotheca* and a species of *Phyllostegia* in Tahiti.

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THE botanical books and articles enumerated below are of two kinds: the one consisting of works on Insular Floras, the other of Floras of Continents, to which references are given in the Reports to descriptions, geographical distribution, and other information concerning the plants which inhabit insular situations. Thus, in the Report on the Botany of the Bermudas, references are given to Chapman's Flora of the Southern United States, to Grisebach's Flora of the British West Indies, and to Gray's Manual of the Botany of the Northern United States, &c., the object being, not so much to adduce authorities for the distribution of species, as to guide the reader to descriptions and fuller synonymy of them. The immense collections at Kew and the British Museum have afforded much nearer complete data on the range of many of the species than has hitherto been published, though we have sometimes been obliged to rely on the writings of other botanists for details: on Miquel, for instance, respecting the distribution of some species in the Malayan Archipelago.

The present list is not offered as an exhaustive one of the literature dealing with our subject, for it was only an afterthought to include it; but we hope we have not overlooked any work of importance, as there was no intention of making a selection. The titles of a number of minor and subsidiary works referred to, or from which extracts are given in the Introductory Notes to the vegetation of the various islands, are not repeated here, because it seemed wholly unnecessary.

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[1] The date on the title-page of this little book is 1883, on the wrapper 1885. It was not received at Kew until the second week in March 1885, just as we were writing the last pages of this Introduction, therefore no reference to it could be made in the Report on the Botany of the Bermudas. But, from a cursory examination, we think the inhabitants who are interested in the botany of the islands will find the descriptions useful.

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